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# SINUS PENTA

MULTIFUNCTION AC DRIVE

# USER MANUAL

## -Programming Instructions-

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*English*

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# 0.4. How to Use this Manual

## 0.4.1. OVERVIEW

This User Manual (Programming Instructions) provides any information required to setup and monitor the inverters of the Sinus Penta series manufactured by Elettronica Santerno SpA.

Setup/monitoring may be obtained using one or both of the following options:

1) Display/keypad unit;

2) Serial link through standard port RS485 or isolated optional serial board ES822 RS485/RS32.

For the instructions on how to use and remote the display/keypad unit, please refer to Sinus Penta Installation Manual.

Any information sent to/from the inverter through the display/keypad unit may be obtained also via serial link using the RemoteDrive software application offered by Elettronica Santerno. RemoteDrive allows the following functions: image acquisition, keypad simulation, oscilloscope functions and multifunction tester, table compiler including operation data log, parameter setup and data reception-transmission-storage from and to a calculator, scan function for the automatic detection of the connected inverters (up to 247 inverters may be connected).

You can also create your own dedicated software via serial communication link. This manual provides any information concerning addressing (Address field) and scaling (Range field) for the inverter interfacing.

## 0.4.2. MENUS AND SUBMENUS

This User Manual (Programming Instructions) is divided into several Menus. Their sequence is the same as their display sequence in the display/keypad and the RemoteDrive software.

Programming parameters and Measure parameters are divided into:

Measure **Mxxx** (always Read Only):

| | | | |
|---|---|---|---|
| **Mxxx** | **Range** | Inverter representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| | **Active** | Type of control (IFD / VTC / FOC) the measure is related to | |
| | **Address** | ModBus address which the measure can be read from<br>(integer) | |
| | **Function** | Measure description | |

Parameters **Pxxx** (always R/W):

| | | | |
|---|---|---|---|
| **Pxxx** | **Range** | Inverter representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| | **Default** | Factory-setting of the parameter<br>(as represented for the inverter) | Factory-setting of the parameter<br>(as displayed)<br>plus unit of measure |
| | **Level** | Access level (BASIC / ADVANCED / ENGINEERING) | |
| | **Address** | ModBus address which the parameter can be read from<br>(integer) | |
| | **Control** | Optional field present if the parameter is active not for all the controls (IFD / VTC / FOC) | |
| | **Function** | Parameter description | |

Parameters **Cxxx** (Read Only with inverter in Run and motor in motion; R/W with inverter on stand-by or in Run, but motor stopped: **see P003** in PASSWORD AND ACCESS LEVEL MENU

| | | | |
|---|---|---|---|
| **Cxxx** | **Range** | Inverter representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| | **Default** | Factory-setting of the parameter<br>(as represented for the inverter) | Factory-setting of the parameter<br>(as displayed)<br>plus unit of measure |
| | **Level** | Access Level (BASIC / ADVANCED / ENGINEERING) | |
| | **Address** | ModBus address which the parameter can be read from or which the parameter can be written to<br>(integer) | |
| | **Control** | Optional field present if the parameter is active not for all the controls (IFD / VTC / FOC) | |
| | **Function** | Parameter description | |

Parameters **Rxxx** (Read Only with inverter in Run; R/W with inverter on stand-by).

NOTE

Unlike **Cxxx** parameters, the **Rxxx** parameters become active only after the inverter has been switched off and switched on again, or after resetting the board by pressing the **RESET** button for 8 seconds.

| Rxxx | | | |
|---|---|---|---|
| | Range | Inverter representation (integer) | Display on the display/keypad and the RemoteDrive (may be a decimal figure) plus unit of measure |
| | Default | Factory-setting of the parameter (as represented for the inverter) | Factory-setting of the parameter (as displayed) plus unit of measure |
| | Level | Access Level (BASIC / ADVANCED / ENGINEERING) | |
| | Address | ModBus address which the parameter can be read from or which the parameter can be written to (integer) | |
| | Control | Optional field present if the parameter is active not for all the controls (IFD / VTC / FOC) | |
| | Function | Parameter description | |

Inputs **Ixxx**. These are not parameters, but inputs (the values assigned to these inputs are not stored to non-volatile memory. Their value is always 0 when the inverter is powered on).

| Ixxx | | | |
|---|---|---|---|
| | Range | Inverter representation (integer) | Display on the display/keypad and the RemoteDrive (may be a decimal figure) plus unit of measure |
| | Level | Access level (BASIC / ADVANCED / ENGINEERING) | |
| | Address | ModBus address which the input can be read from or which the input can be written to (integer) | |
| | Control | Optional field present if the parameter is active not for all the controls (IFD / VTC / FOC) | |
| | Function | Input description | |

NOTE

When a parameter is modified from the display/keypad, you may activate its new value immediately (flashing cursor) or when you quit the programming mode (fixed cursor).
Typically, numeric parameters immediately come to effect, while alphanumeric parameters have a delayed effect.

NOTE

Vice versa, when you modify a parameter using RemoteDrive, the inverter will immediately use the new parameter value.

## 0.4.3. ALARMS AND WARNINGS

The last part of this User Manual covers alarms **Axxx** and warnings **Wxxx** displayed by the inverter:

| Axxx | | |
|---|---|---|
| | Description | |
| | Event | |
| | Possible cause | |
| | Solution | |

# 1. USING THE DISPLAY/KEYPAD UNIT

## 1.1. Overview

This section contains several examples for navigation in the display/keypad unit and the UPLOAD and DOWNLOAD functions of the programming settings of the inverter using the keypad.

For details regarding the particular settings of the keypad (contrast, backlight, etc.) please refer to the section concerning the display/keypad in the Installation Manual, whilst for details regarding customising navigation of the root page, the measures in the Keypad page and the Root page and the PID customised unit of measure, refer to the DISPLAY/KEYPAD MENU of this manual.

When using the menu navigation mode **P264** = MENU, the structure of the menu tree where it is possible to navigate with the Display/Keypad is that described in the paragraph Menu Tree.

The structure shown is complete; the effective structure depends on the program level set in **P001** and on the programming set. For example, if only one **C009**=1motor has been programmed, the menus for motors 2 and 3 will not be displayed (Configuration Motor 2/3 and Limit Motor 2/3). In addition, if there is **C010**=IFD Voltage/Freq. programmed motor control, the BRIDGE CRANE menu will also not be displayed.

By using linear navigation **P264** = Linear, the settings displayed are no longer grouped into menus and it is possible to navigate in all the settings using the ▲ and ▼ keys.
If using the navigation **P264** = Modified Only, only the settings with programming different to the factory settings will be displayed and it is possible to navigate in all the settings using the ▲ and ▼ keys.

An example of the use of keys for navigation and modifying settings is contained in the section Examples of Navigation (**P264** = MENU).

The following paragraphs contain descriptions for the use of some of the keys and their functions.

## 1.2. Menu Tree

MENU TREE

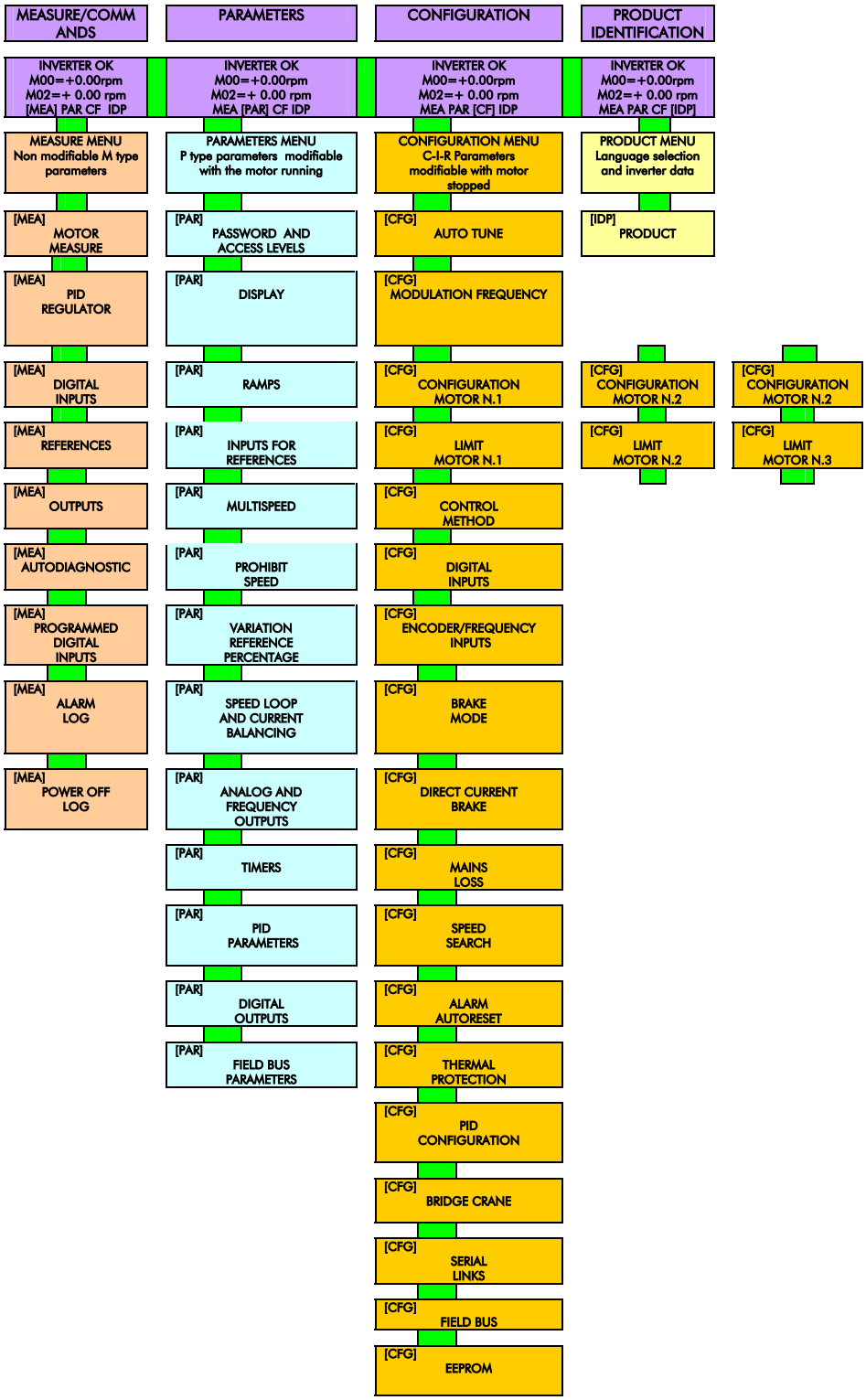
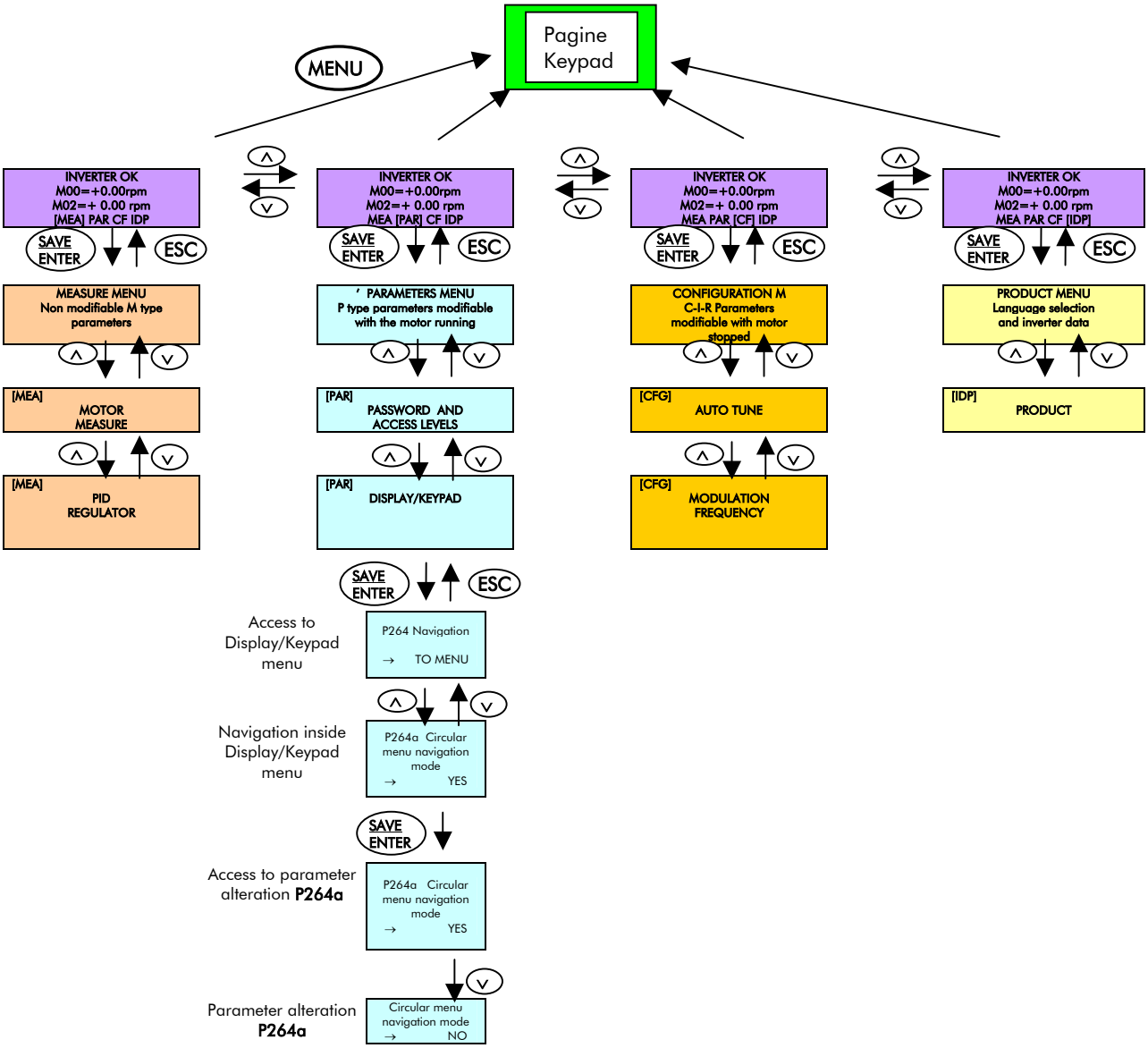



Figure 1: Menu Tree Structure

## 1.3 Navigation




The parameter will not be saved in the non-volatile memory if the **ESC** key is pressed to quit and will therefore be lost when shut down. On the contrary, press **SAVE/ENTER** to confirm the alteration.

**Figure 2: Example of navigation**

## 1.4. Parameter Alteration

With factory setting, parameter alteration is possible. The parameters included in the Parameter Menu (identified by **Pxxx)** can always be changed; instead the parameters included in the Configuration Menu (identified by **Cxxx**, **Rxxx**, **Ixxx**) can be modified only with the motor stopped.
To respect better safety condition, it is necessary to modify the configuration parameters only with the inverter disabled (ENABLE command inactive): to do so, **P003** has to be set to 0 (only in standby).

To disable parameter alteration it is sufficient to modify and save **P000** (writing enable). With factory setting **P000** and **P002** (password) are both equal to 1; setting **P000=0** the parameters **cannot** be modified, instead with **P000=1** it is possible to make change.
To improve protection condition, it is possible to change the password memorized in **P002.**

NOTE It is recommended to note and keep the value of **P002**.

To make alterations, press the **SAVE/ENTER** key; when a flashing cursor appears, press ▲ and ▼ to change the parameter value. Use one of the following operations to quit the editing mode:
Press **ESC** → the parameter value used by the inverter is altered and is maintained until the inverter is shut down.
Press **SAVE/ENTER** → the parameter value is stored to non-volatile memory and is not deleted when the inverter is shut down.

Inputs (**Ixxx**) cannot be saved to non-volatile memory and are automatically set to their default values after they have performed their function.

Parameters **Rxxx** become active only when the inverter control board has been reset by pressing the **RESET** key for a few seconds or by switching off the inverter.

## 1.5. Programming the Startup Page

The factory settings of the Startup Page of the display/keypad that is displayed when the inverter is switched on show the Root page from where it is possible to access the various menus (Measure, Parameters, Configuration, Product ID) or shift to the Keypad pages using the **MENU** key.

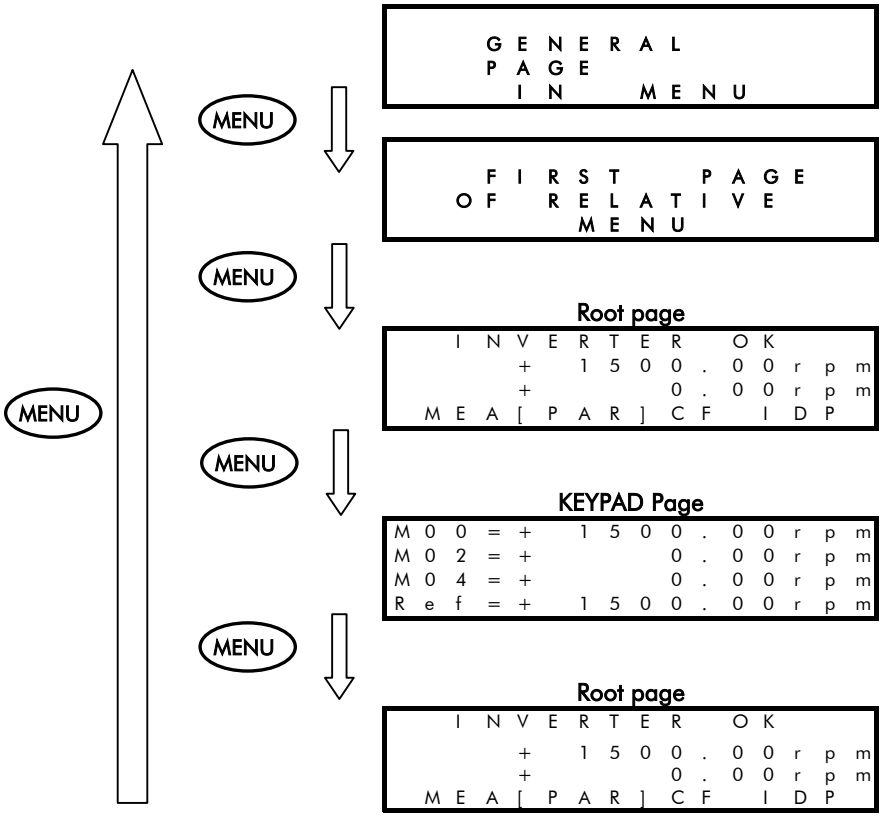
Root page

```
    I N V E R T E R    O K
          +   1 5 0 0 . 0 0 r p m
          +         0 . 0 0 r p m
  M E A [ P A R ] C F    I D P
```

It is possible to customise the Startup Page by using parameter **P265** (see DISPLAY/KEYPAD MENU).

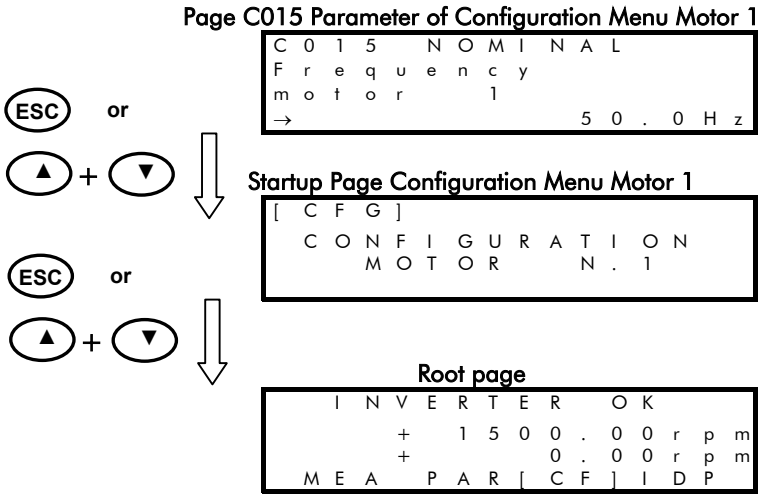
## 1.6. Using the MENU Key

The **MENU** key makes it possible to scroll through the internal menus, whilst from the Root page it is possible to scroll to the Keypad pages.

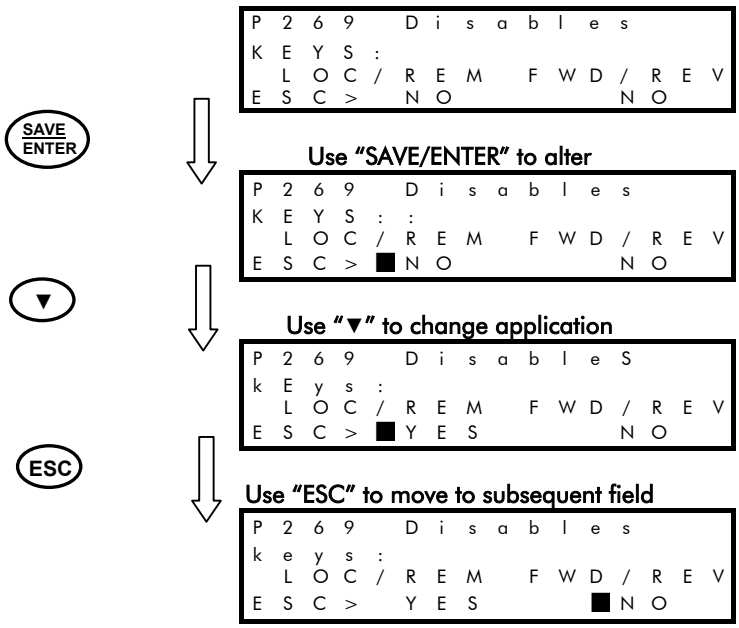


## 1.7. ESC Key (contemporary use of the ▲ and ▼ Keys)

The contemporary pressing of the ▲ and ▼ keys performs the same function as pressing the **ESC** key and makes it possible to move up one level in the menu tree.
In the following example, starting from the **C015** parameter of the First Motor Submenu inside the Configuration Menu, it is possible to move up to the Root page by using the **ESC** key or by pressing the ▲ and ▼ keys simultaneously.




When altering a parameter (using the **SAVE/ENTER** key) that has more fields of application (for this reason, the signal ESC> appears on the display in correspondence to the **ESC** key), the **ESC** key is used to move the alteration to the subsequent field (in the following example **P269** has 2 programmable fields).




To quit the last page shown in the example use:

- **ESC** without saving in eeprom
- **SAVE/ENTER** to save in eeprom.

## 1.8. RESET Key (reset alarms and control board)

The **RESET** key is used to reset the inverter after an alarm has tripped and the cause that generated the alarm has been removed.

Press the **RESET** key for **at least 8 seconds to reset the control board** and reinitiate it. This procedure may be useful when it is necessary to make modifications made to programming immediately operative on the **Rxxx** type parameters (active only after a reset) without necessarily having to switch off the inverter.

## 1.9. TX/RX Key (Download/Upload from/to the keypad)

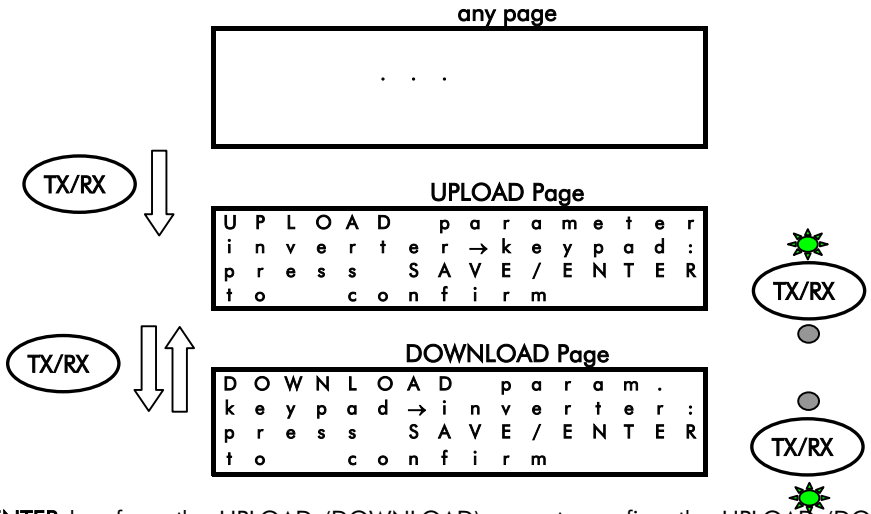
Using the keypad it is possible to perform the UPLOAD (parameters stored in the drive are copied to the keypad) and DOWNLOAD (parameters stored in the keypad are copied to the drive) functions.
Press the **TX/RX** key to go to the UPLOAD page; press the **TX/RX** key again to toggle between the UPLOAD and DOWNLOAD pages.

NOTE **Trying to DOWNLOAD parameters to a drive with SW Version, IDP, PIN or current or voltage classes different from the drive the parameters were previously UPLOADED from causes a WARNING (from W41 to W46) and the operation is inhibited.**

The functioning of the **TX/RX** key is disabled in the following conditions:

- when the **P000** password has not been inserted
- when navigation with the **MENU** key is in OPERATOR (**P264b** = OPERATOR)
- when the inverter is running (UPLOAD works only)

In the example below, starting from any page we move to the UPLOAD page of the parameters of the inverter (upper LED flashing); by subsequently pressing the **TX/RX** key it is possible to toggle between the UPLOAD and DOWNLOAD pages.




Press the **SAVE/ENTER** key from the UPLOAD (DOWNLOAD) page to confirm the UPLOAD (DOWNLOAD) operation, signalled by the LED switched on.
If the operation with the **SAVE/ENTER** key is not confirmed within 10 seconds, the display/keypad automatically returns to the page we started from.
During the UPLOAD operation, the respective flashing warning light **W08 UPLOADING** is switched on. If the procedure is successful, the following warning is displayed:
**W11 UPLOAD OK**
If unsuccessful, the warning light **W12 UPLOAD KO** will be switched on and it will be necessary to repeat the operation.
During the DOWNLOAD operation, the respective flashing warning light **W07 DOWNLOADING** is switched on. If the procedure is successful, the following warning is displayed:
**W09 DOWNLOAD OK**
If the DOWNLOAD operation is unsuccessful, alarm **A073** is generated and it will be necessary to repeat the operation.

## 1.10. LOC/REM Key (Keypad pages)

The Keypad page can be used in Local/Remote, where remote sources are command and reference sources other than the display/keypad, by pressing the **LOC/REM** key in the display/keypad or by using a digital input configured as **Loc/Rem** (see **C180**).

NOTE

The LOC/REM key is operating if no digital input is configured as **Loc/Rem** or if it is configured as **Loc/Rem**, but as a pushbutton (see **C180a**).
The LOC/REM key is not operating if a digital input is configured as **Loc/Rem** and as a switch (see **C180a**).

By using the **C148** programming we can determine if the passage from the Remote to Local mode and vice versa may be effected only with the inverter disabled or not. It is also possible to determine if in the passage from remote to local, the running status, but not the reference, remains unaltered (bumpless commands), or if both are preserved (all bumpless). For a more detailed explanation, refer to the description for **C148** (see CONTROL METHOD MENU).

When in the LOCAL mode (indicated by the L-CMD and L-REF leds), for which the commands and references of the inverter are displayed by the display/keypad, the Keypad page is used to vary the reference by using the ▲ and ▼ keys (see **P266** in DISPLAY/KEYPAD MENU).
When not in the LOCAL mode, the Keypad pages can be accessed via the Root page by using the **MENU** key and only the keypad pages with references from which amongst the sources the Keypad has been selected will be displayed, in addition to the measures Keypad page.
For example, if the parameter Selection reference torque limit **C147** = Keypad, from the Root page by pressing the **MENU** key, the measures only keypad page will be displayed. When pressing this key again, the Keypad page of the torque limit where it is possible to alter the torque limit reference is displayed, using the ▲ and ▼ keys.
measures contained in the Keypad page may be customised, see parameters **P268b** ÷ **P268e** in DISPLAY/KEYPAD MENU.

By using the SAVE/ENTER key, it is possible to have access to the help page of the Keypad, which shows the measures displayed in the Keypad page.

## 1.11. SAVE/ENTER Key

The **SAVE/ENTER** key makes it possible to scroll down within the menus during navigation and when in a general page of parameters makes it possible for alterations. See Figure 2: Example of navigation.
From the Keypad pages, the **SAVE/ENTER** key gives access to the help page of the Keypad, which shows the measures displayed in the keypad page.

## 1.12. Signal LEDs in the display/keypad

There are 11 LEDs on the display/keypad module, the four line liquid crystal display of sixteen characters, a buzzer and 12 keys. The display shows the values of the parameters, the diagnostic measures, and the value of the variables elaborated by the inverter.
The explanations of the signal LEDs are summarised in the figure below, which also makes it possible to identify their position on the front of the display/keypad module.

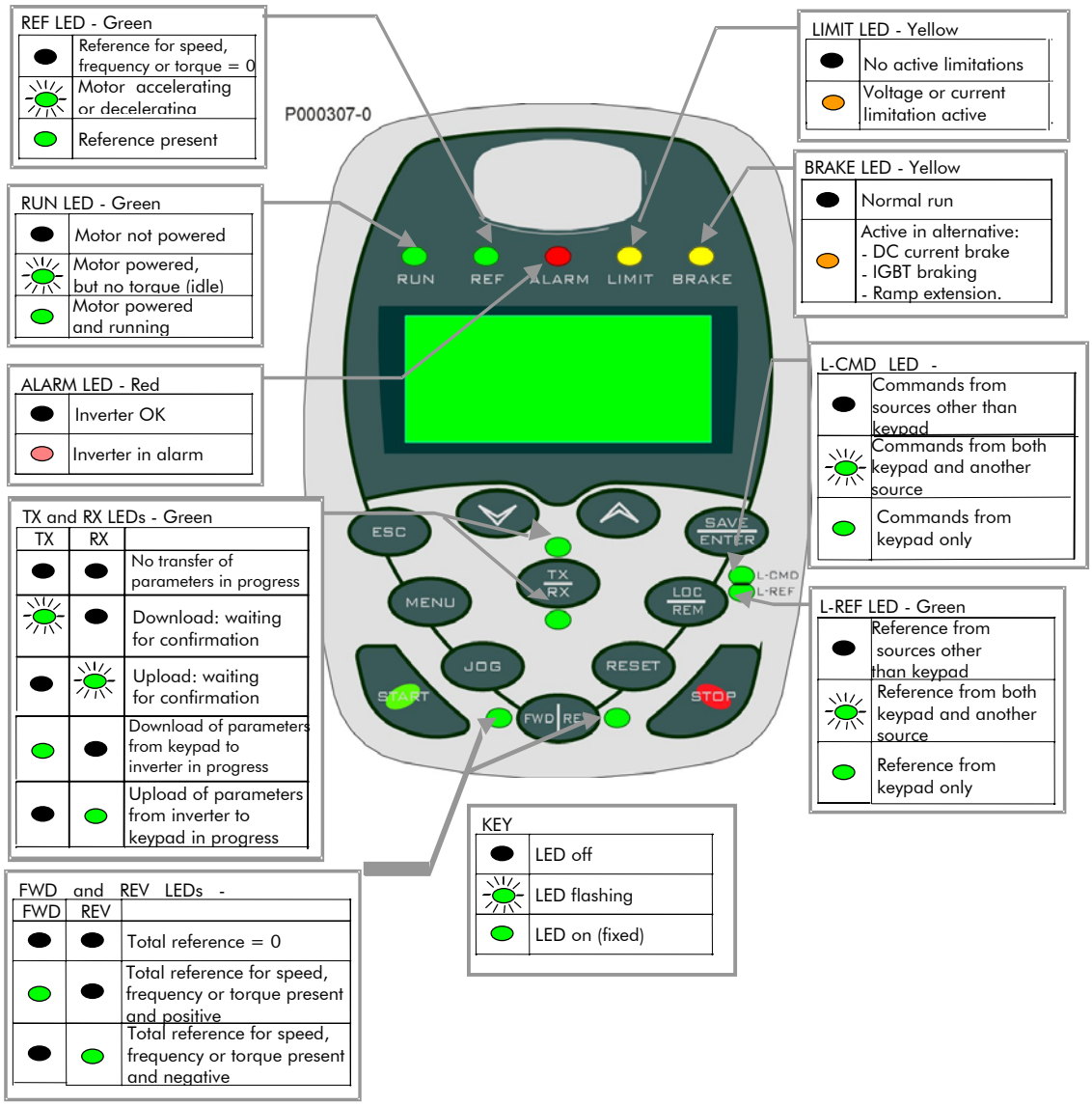



Figure 3: Display/Keypad

# 2. DESCRIPTION OF INPUT AND OUTPUT SIGNALS

The Sinus Penta series inverter has a control board with the following inputs and outputs:

- **3 Analog Inputs** (REF type single ended, AIN1 and AIN2 differential) that are programmable in voltage or current with Dip-switch SW1 (see the DIP-Switches Configuration in the Installation Manual).
- **3 Analog Outputs** that are programmable in voltage or current with Dip-switch SW2 (see the DIP-Switches Configuration in the Installation Manual).
- **8 multifunction digital inputs MDI** of which three are of quick acquisition and can be used to acquire frequency or encoder signals (MDI6 MDI7 and MDI8).
  MDI6 may be used to acquire a frequency signal denominated FINA or coupled with MDI7 to acquire a push-pull encoder signal denominated Encoder A.
  MDI8 may be used to acquire a frequency input denominated FINB (this precludes the possibility of acquiring encoder B with optional board ES836).
- **4 multifunction digital outputs MDO**; of which MDO1 of Push-pull type, MDO2 Open Collector and MDO3 and 4 with relay.

For the electrical characteristics of the control board inputs and outputs, please refer to the paragraphs "xxxx Characteristics" of the Installation Manual.

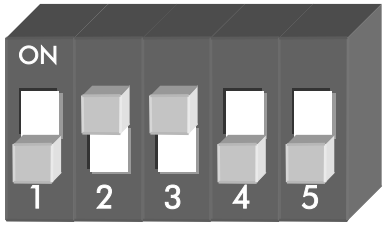
For the programming of:

- **Analog inputs** see INPUT REFERENCES MENU
- **Analog outputs** see ANALOG AND FREQUENCY OUTPUTS MENU
- **Digital Inputs** see DIGITAL INPUTS MENU
- **Digital inputs used as Frequency or Encoder inputs** see ENCODER/FREQUENCY INPUTS MENU
- **Multifunction digital outputs** see DIGITAL OUTPUTS MENU

CAUTION

The factory-setting for the inverter is to have REF input configured for 0-10V input and AIN1 and AIN2 configured for 4-20mA.
These settings require that SW1 dip switches, which are located on the control board, are in the following position:

SW1



# 3. REFERENCES

The references of the inverter may be as follows:

- Processing speed/torque references
- Torque limit references
- PID references
- PID feedback references

## 3.1. Speed/Torque references

If the type of control used is a speed control (e.g. for Motor 1 **C011 = Speed)** the main reference is a speed reference, whilst if the programmed control is in torque (e.g. for Motor 1 **C011=Torque** or **C011=Speed,** but the digital input is closed for the Slave programmed with C170), the main reference of the inverter is a torque reference.

The main reference may be made up of:

- The sum of analog/digital inputs programmed as sources (see parameters **C143-C146** in CONTROL METHOD MENU)
- The PID output if **C294 PID Implementation = Reference**
- From the digital inputs programmed as Multispeed (see MULTISPEED MENU) only when the main reference is a speed reference.

## 3.2. Torque Limit references

If the type of control used is a speed control (e.g. for Motor 1 **C011 = Speed)** and the algorithm is VTC or FOC, it is possible to program a source as torque limit (see parameter **C147** in CONTROL METHOD MENU).

## 3.3. PID References

If the internal PID regulator is enabled **(C291 different from disabled)** its reference is given by the sum of the three sources programmed as references (see parameters **C285-C287** in PID CONFIGURATION MENU).

## 3.4. PID Feedback References

The PID feedback is the sum of the three sources programmed as feedback (see parameters **C288-C290** in PID CONFIGURATION MENU).

# 4. PROGRAMMABLE FUNCTIONS

## 4.1. Multimotor

The Penta inverter has the special feature of being able to set up 3 independent sets of parameters so as to allow for the configuration of three different control algorithms on three types of different motors. For example, by programming:

- C009 Number of motors configured=2
- C173 Digital input per motor 2 = MDI6

With the MDI6 digital input open, the parameters are used for the motor control and are those relative to motor 1, whilst with MDI6 closed, the parameters are relative to motor 2 (see MOTOR CONTROL MENU and LIMITS MENU).

## 4.2. Voltage/Frequency Pattern

If using an IFD Volt./Freq control algorithm (e.g. motor 1 **C010 = IFD Tens/Freq** ) it is possible to select several types of V/f patterns (see paragraph V/f Pattern (IFD Only)).

## 4.3. Slip Compensation

If using an IFD Volt./Freq control algorithm (e.g. motor 1 **C010 = IFD Tens/Freq** ) it is possible to program a slip compensation for more accurate speed control (see paragraph Slip Compensation (IFD Only) ).

## 4.4. Speed Searching

If using an IFD Volt./Freq control algorithm (e.g. motor 1 **C010 = IFD Tens/Freq** ) it is possible to program the speed searching function of the motor rotation speed, which is useful when the inverter must control a motor that cannot be still from the start (e.g. fans). See the SPEED SEARCHING MENU for information regarding programming parameters and a description of this function.

## 4.5. Controlled stop in case of power failure (Power Down)

See the POWER DOWN MENU for information on programming a controlled stop in the case of power failure.

## 4.6. DC Braking

If using an IFD Volt./Freq or VTC VectorTorque control algorithm, it is possible to program DC braking at start or at stop. For the IFD Volt./Freq control, it is possible to also program the holding function. See the DC BRAKING MENU for information regarding programming parameters and a description of this function.

## 4.7. Motor Thermal Protection

It is possible to program thermal protection of the motor against overloads. This protection can be carried out using the PTC acquired at the AIN2 analog input or using software with an algorithm that reconstructs the thermal image of the motor. In case of termal protection with PTC, it is possible to connect up to 6 in series.
See the MOTOR THERMAL PROTECTION MENU for information regarding programming parameters and a description of this function.
For detailed description about the use of AIN input see the INSTALLATION MANUAL.

## 4.8. Prohibit Speeds

It is possible to program speed ranges corresponding to the frequencies of mechanical resonance to be avoided for the inverter to function.
See the PROHIBIT SPEED MENU for information regarding programming parameters and a description of this function.

## 4.9. Digital PID Regulator

The inverter has a digital PID regulator (proportional, integral, derivative) that can be used to generate:

- Analog output
- Main reference of the inverter (Speed/Torque reference)
- Correction of main reference
- Correction of output voltage (only for IFD Volt/Freq. control)

See the PID PARAMETERS MENU and the PID CONFIGURATION MENU for information regarding programming parameters and a description of this function.

## 4.10. Bridge Crane Application

For lifting applications such as a bridge crane, it may be useful to consider the effective time required for the release of the electromechanical safety brake (the delay between the electrical command and the actual opening of the brake) and the closing of the electromechanical brake.
For a description of the advantages of programming specific parameters for the lifting application, see the BRIDGE CRANE MENU..

## 4.11. Setting of two command sources and an alternative reference

It is possible to program a digital input as the vector between 2 command sources and an alternative reference.
For example:
for a desired vector for the preselection of a **command B** mode with reference and commands of the inverter from Field Bus and a **mode A** with keypad commands and AIN1 analog input reference.
The following parameters must be programmed:

**C179** MDI for source selection = **MDI6**
**C140** Source selection of command number 1 = **Keypad**
**C141** Source selection of command number 2 = **Field Bus**
**C143** Reference selection 1 = **AIN1**
**C144** Reference selection 2 = **Field Bus**

With MDI6 digital input from open terminal ( terminal 19 ), the reference sources and command n. 1 are opened. (Keypad and AIN1 analog input command A mode. By closing MDI6 , the source references and command n. 2 are selected (Field Bus command B mode).

WARNING

If in this example **C179 = Disable** the two command sources Keypad and Field Bus are considered in OR and the two reference sources Field Bus and AIN1 are considered in sum.

See parameter **C179** of the DIGITAL INPUTS MENU.

## 4.12. Fire Mode

By activating the digital input programmed as FIRE MODE, this function puts the inverter in an operational condition where all the protections are ignored, so as to continue functioning without generating alarms.

WARNING

**The Fire Mode function must be used only when it is strictly necessary, such as in fire pumps for the protection of human lives.**
**This function must in no way be used for avoiding tripping alarms in civil or industrial applications.**

In order to set the Fire Mode parameters it is necessary to insert the Password for access to the Fire Mode in the PRODUCT MENU. To find out the password, contact Elettronica Santerno Customer Service with the Serial Number of the product (see Serial Number parameter of the PRODUCT MENU).
Only once the correct password is inserted for access to Fire Mode, the following parameters will be displayed:

- **P032** Acceleration ramp in Fire Mode (see RAMPS MENU)
- **P033** Deceleration ramp in Fire Mode (see RAMPS MENU)
- **P099** Speed in Fire Mode (see MULTISPEED MENU)
- **C186** MDI for access to Fire Mode (see DIGITAL INPUTS MENU)

If the MDI programmed with **C186** is closed, the Fire Mode is enabled. In this mode, the inverter uses the speed reference programmed in **P099** using the **P032**, **P033** ramp times, all alarms are ignored, except those that are truly destructive for the inverter:

| | | |
|---|---|---|
| **A041** | IGBT FAULT Side A | Hardware Alarm IGBT side A general |
| **A044** | OVERLOAD SW | Overload Software |
| **A048** | OVER VOLTAGE | Voltage of Bus–DC greater than Vdc_max |
| **A050** | IGBT FAULT A | Hardware Fault from Convertor IGBT side A |
| **A051** | OVERLOAD HW A | Overload Hardware side A |

When in Fire Mode, an infinite number of alarm autoresets are automatically enabled.

WARNING

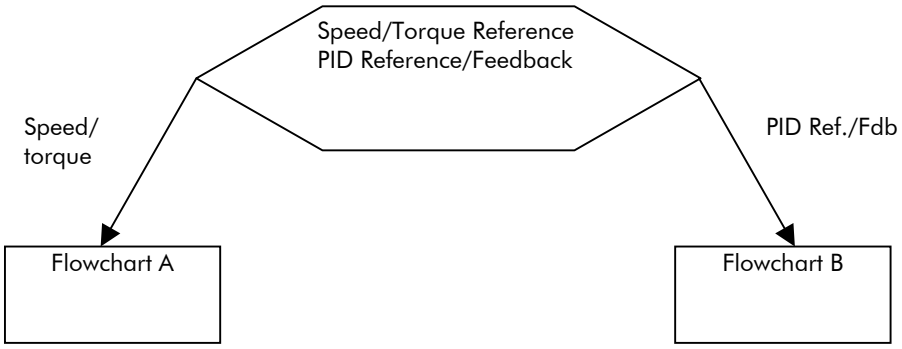
**The signal (*) with the letters INVERTER OK on the display will cause a decay in the guarantee of the product.**
**This asterisk appears when at least once during functioning in the Fire Mode, an alarm that might be damaging for the integrity of the drive was ignored.**

# 5. PROGRAMMING EXAMPLES

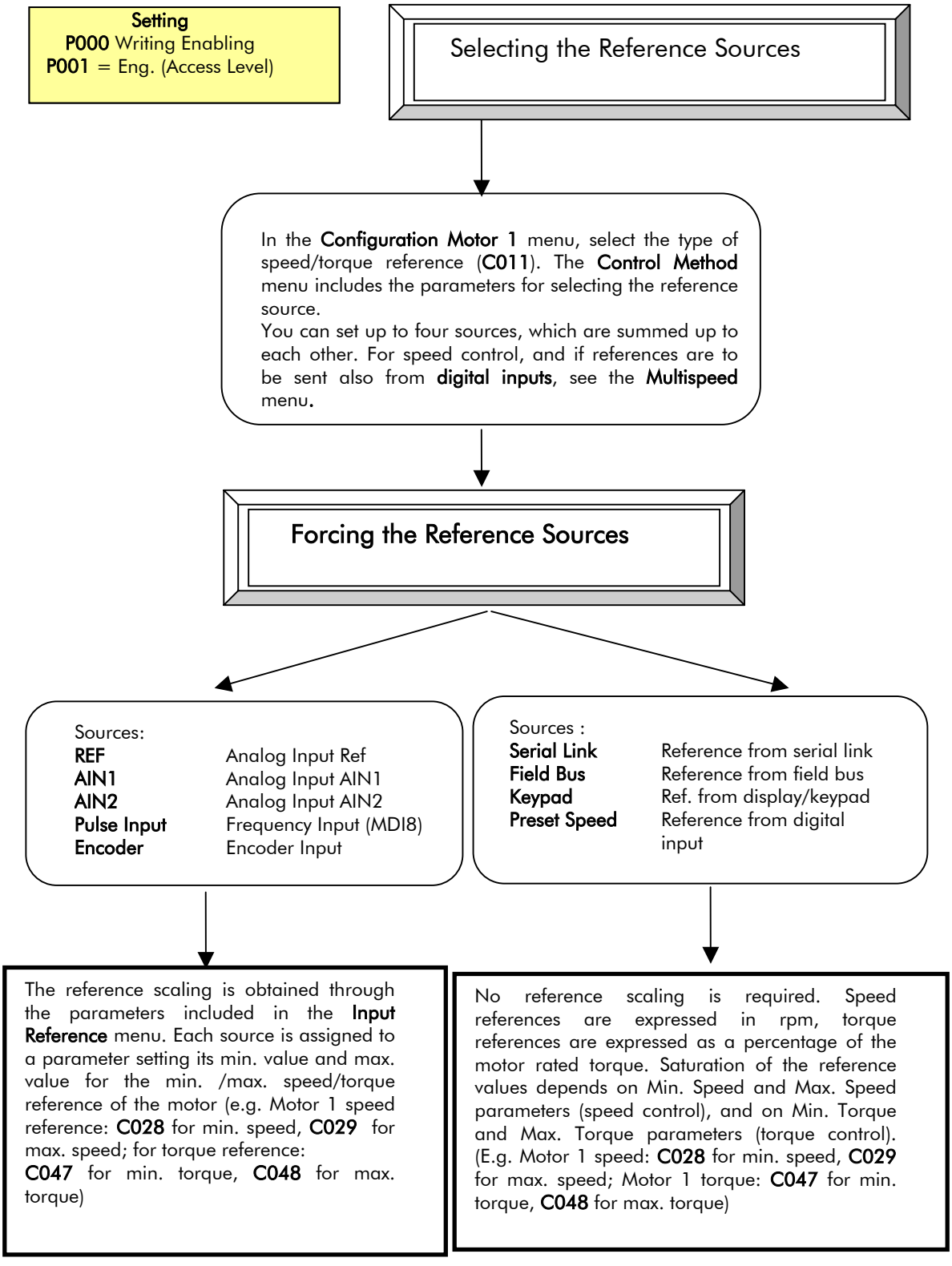
## 5.1. Overview

This section illustrates some programming examples for particular functions of the inverter. Flowcharts are used for easier reference.
For any detail concerning individual parameters, see the relevant explanations in the sections dedicated to each menu of the Programming Instructions.

## 5.2. Reference Programming



FLOWCHART A


Setting
P000 Writing Enabling
P001 = Eng. (Access Level)
Selecting the Reference Sources
In the Configuration Motor 1 menu, select the type of speed/torque reference (C011). The Control Method menu includes the parameters for selecting the reference source.
You can set up to four sources, which are summed up to each other. For speed control, and if references are to be sent also from digital inputs, see the Multispeed menu.
Forcing the Reference Sources
Sources:
REF Analog Input Ref
AIN1 Analog Input AIN1
AIN2 Analog Input AIN2
Pulse Input Frequency Input (MDI8)
Encoder Encoder Input
Sources :
Serial Link Reference from serial link
Field Bus Reference from field bus
Keypad Ref. from display/keypad
Preset Speed Reference from digital input
The reference scaling is obtained through the parameters included in the Input Reference menu. Each source is assigned to a parameter setting its min. value and max. value for the min. /max. speed/torque reference of the motor (e.g. Motor 1 speed reference: C028 for min. speed, C029 for max. speed; for torque reference: C047 for min. torque, C048 for max. torque)
No reference scaling is required. Speed references are expressed in rpm, torque references are expressed as a percentage of the motor rated torque. Saturation of the reference values depends on Min. Speed and Max. Speed parameters (speed control), and on Min. Torque and Max. Torque parameters (torque control). (E.g. Motor 1 speed: C028 for min. speed, C029 for max. speed; Motor 1 torque: C047 for min. torque, C048 for max. torque)

FLOWCHART B

**Setting**
**P000** Writing Enabling
**P001** = Eng. (Access Level)

Selecting the Reference/Feedback Sources

The **PID Configuration** menu includes the parameters selecting the reference/feedback source.
You can set up to three sources, which are summed up to each other.

Forcing the Reference/Feedback Sources

Sources:

| | |
|---|---|
| **REF** | Analog Input Ref |
| **AIN1** | Analog Input AIN1 |
| **AIN2** | Analog Input AIN2 |
| **Pulse Input** | Frequency Input (MDI8) |
| **Encoder** | Encoder Input |

The reference scaling is obtained through the parameters included in the **Reference** menu. Each source is assigned to a parameter setting its min. value and max. value for the min./max. PID Reference/Feedback value.
See **PID Parameters** menu

| | |
|---|---|
| Reference | **P245** Min., **P246** Max. |
| Feedback | **P247** Min., **P248** Max. |

Sources :

| | |
|---|---|
| **Serial Link** | Reference from serial link |
| **Field Bus** | Reference from field bus |
| **Keypad** | Ref. from display/keypad |

Feedback reference only :

| | |
|---|---|
| **Iout** | Output current |
| **Vout** | Output voltage |
| **Vdc** | DC bus voltage |

No reference scaling is required. References are expressed as a percentage. As a feedback reference, output current (Iout), output voltage (Vout), DC bus voltage (Vdc) are available, which respectively refer to the following: as FULL SCALE VALUE
Rated current of the selected motor (Mot.1 **C018**)
Rated voltage of the selected motor (Mot.1 **C019**)
DC 1500 V.

# EXAMPLE

The speed of a motor is to be controlled through a 0 ÷ 5 V analog input. Speed range is 0 ÷ 1500 rpm; two digital inputs are available to increase three speed values with steps of 100rpm.

**Setting the min. and max. speed:**
The parameters for the motor min./max. speed are **C028** = 0 rpm, **C029** = 1800 rpm.

**Setting the analog reference:**
Default setting: the analog reference is sent from input REF (**C143** = REF).
The speed range for the analog input must be 0 ÷ 1500 rpm.

Default setting in the Reference Menu for REF analog input:
**P050** = 3: 0 –10 V Type of reference for REF input
**P051** = 0.0 V Min. value for REF input
**P052** = 10.0 V Max. value for REF input

**P052** is the voltage value for REF for a speed reference of 1800rpm (**C029**)
For a speed reference of 1500rpm with 5 V, **P052** is to be set as follows:
(Max. speed REF) : (5 V) = (**C029**) : (Vx)
Vx = 5 V *1800rpm /1500rpm = 6 V
If **P052** = 6V, a speed reference of 1500rpm is set for REF with 5V.

**Setting the reference from digital inputs:**

Default setting: two digital inputs for multispeed values.
**Digital Inputs** menu: **C155** = MDI4 ; **C156** = MDI5
Depending on the status of digital inputs MDI4 and MDI5:

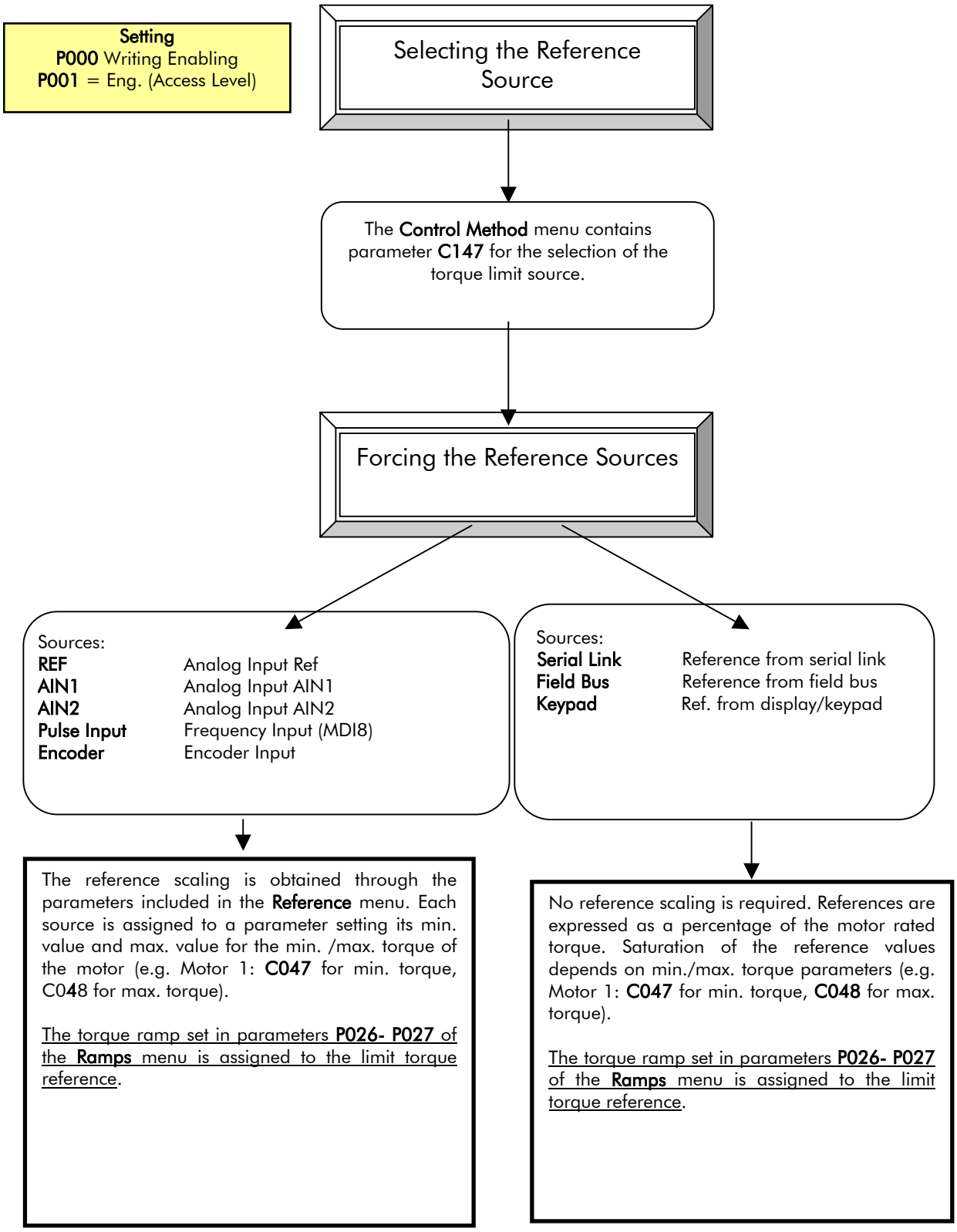
| MDI4 | MDI5 | Multispeed |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 2 |
| 1 | 1 | 3 |

In the **Multispeed** menu, set the speed steps as follows:

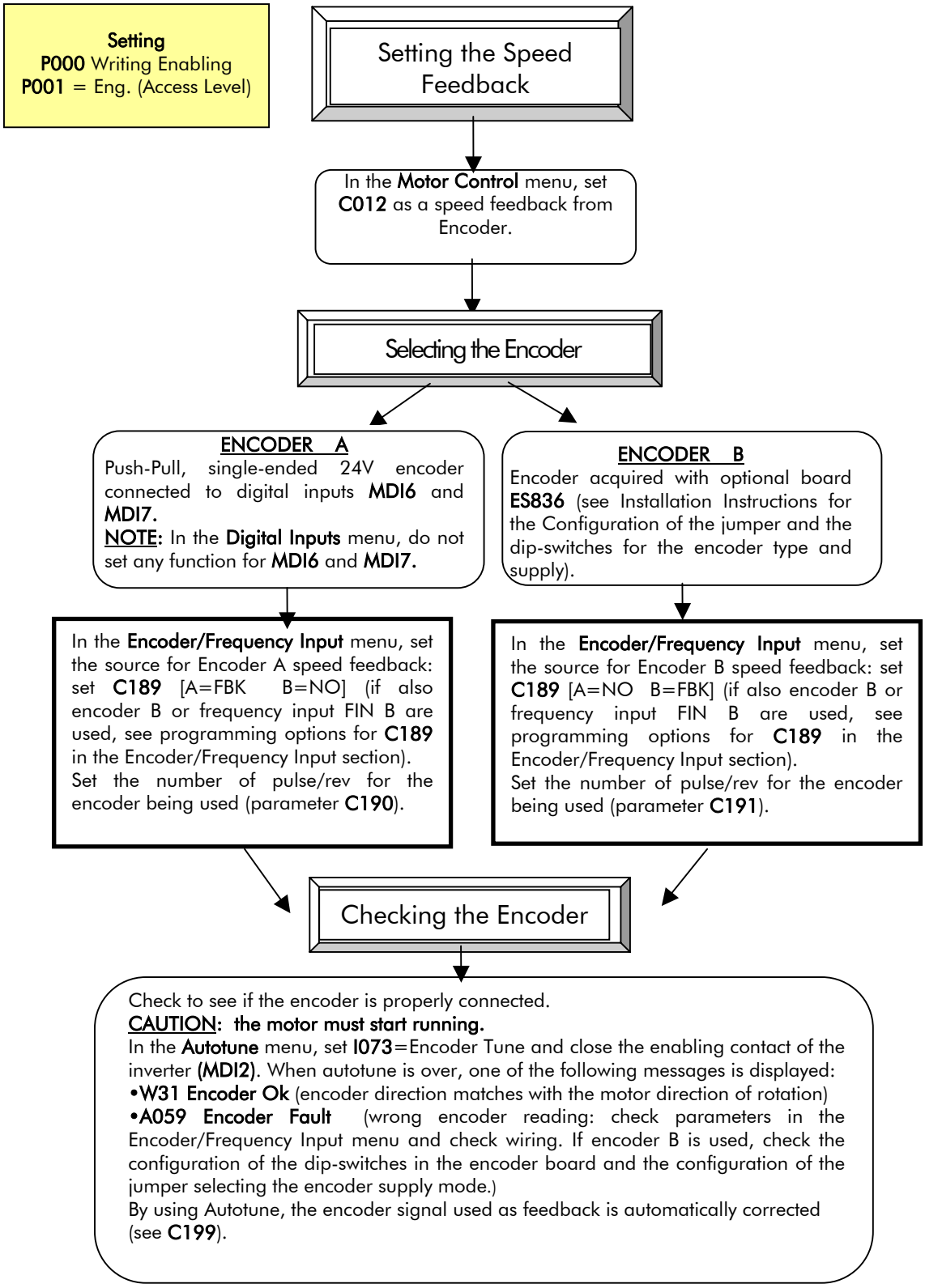
**P080** = 1: Sum Speed
**P081** = 100rpm Multispeed 1
**P083** = 200rpm Multispeed 2
**P085** = 300rpm Multispeed 3

**P080** → Multispeed function: the selected multispeed is summed up to the reference for the analog input.
**P081**, **P083**, **P085** are the steps depending on the selected multispeed for digital inputs MDI4, MDI5.

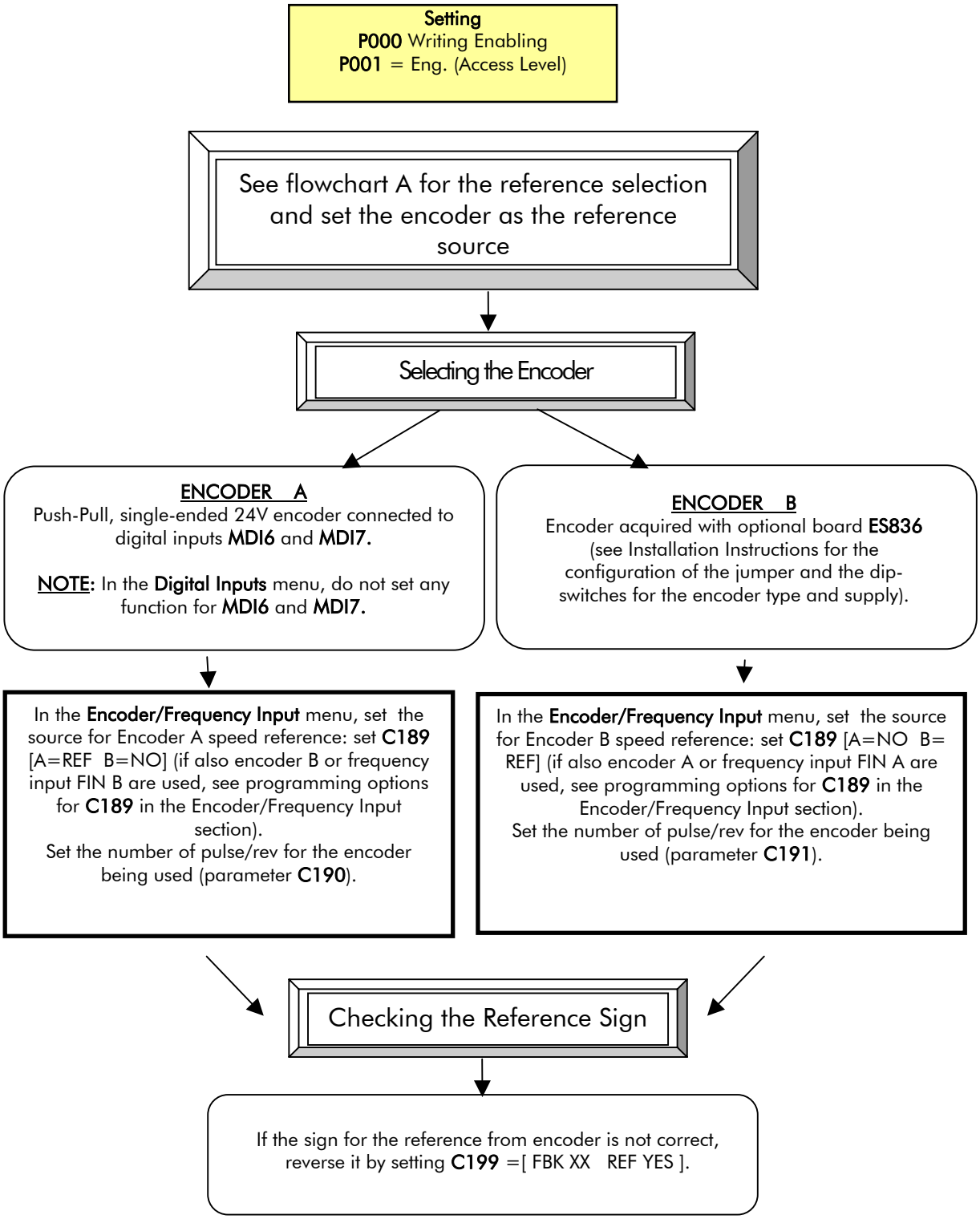
## 5.3. Configuring an External Torque Limit


Setting
P000 Writing Enabling
P001 = Eng. (Access Level)
Selecting the Reference Source
The Control Method menu contains parameter C147 for the selection of the torque limit source.
Forcing the Reference Sources
Sources:
REF Analog Input Ref
AIN1 Analog Input AIN1
AIN2 Analog Input AIN2
Pulse Input Frequency Input (MDI8)
Encoder Encoder Input
Sources:
Serial Link Reference from serial link
Field Bus Reference from field bus
Keypad Ref. from display/keypad
The reference scaling is obtained through the parameters included in the Reference menu. Each source is assigned to a parameter setting its min. value and max. value for the min. /max. torque of the motor (e.g. Motor 1: C047 for min. torque, C048 for max. torque).
The torque ramp set in parameters P026- P027 of the Ramps menu is assigned to the limit torque reference.
No reference scaling is required. References are expressed as a percentage of the motor rated torque. Saturation of the reference values depends on min./max. torque parameters (e.g. Motor 1: C047 for min. torque, C048 for max. torque).
The torque ramp set in parameters P026- P027 of the Ramps menu is assigned to the limit torque reference.

## 5.4. Configuring a Feedback from Encoder


Setting
P000 Writing Enabling
P001 = Eng. (Access Level)
Setting the Speed Feedback
In the Motor Control menu, set C012 as a speed feedback from Encoder.
Selecting the Encoder
ENCODER A
Push-Pull, single-ended 24V encoder connected to digital inputs MDI6 and MDI7.
NOTE: In the Digital Inputs menu, do not set any function for MDI6 and MDI7.
ENCODER B
Encoder acquired with optional board ES836 (see Installation Instructions for the Configuration of the jumper and the dip-switches for the encoder type and supply).
In the Encoder/Frequency Input menu, set the source for Encoder A speed feedback: set C189 [A=FBK B=NO] (if also encoder B or frequency input FIN B are used, see programming options for C189 in the Encoder/Frequency Input section).
Set the number of pulse/rev for the encoder being used (parameter C190).
In the Encoder/Frequency Input menu, set the source for Encoder B speed feedback: set C189 [A=NO B=FBK] (if also encoder B or frequency input FIN B are used, see programming options for C189 in the Encoder/Frequency Input section).
Set the number of pulse/rev for the encoder being used (parameter C191).
Checking the Encoder
Check to see if the encoder is properly connected.
CAUTION: the motor must start running.
In the Autotune menu, set I073=Encoder Tune and close the enabling contact of the inverter (MDI2). When autotune is over, one of the following messages is displayed:
•W31 Encoder Ok (encoder direction matches with the motor direction of rotation)
•A059 Encoder Fault (wrong encoder reading: check parameters in the Encoder/Frequency Input menu and check wiring. If encoder B is used, check the configuration of the dip-switches in the encoder board and the configuration of the jumper selecting the encoder supply mode.)
By using Autotune, the encoder signal used as feedback is automatically corrected (see C199).

## 5.5. Configuring a Reference from Encoder


Setting
P000 Writing Enabling
P001 = Eng. (Access Level)
See flowchart A for the reference selection and set the encoder as the reference source
Selecting the Encoder
ENCODER A
Push-Pull, single-ended 24V encoder connected to digital inputs MDI6 and MDI7.
NOTE: In the Digital Inputs menu, do not set any function for MDI6 and MDI7.
ENCODER B
Encoder acquired with optional board ES836 (see Installation Instructions for the configuration of the jumper and the dip-switches for the encoder type and supply).
In the Encoder/Frequency Input menu, set the source for Encoder A speed reference: set C189 [A=REF B=NO] (if also encoder B or frequency input FIN B are used, see programming options for C189 in the Encoder/Frequency Input section).
Set the number of pulse/rev for the encoder being used (parameter C190).
In the Encoder/Frequency Input menu, set the source for Encoder B speed reference: set C189 [A=NO B= REF] (if also encoder A or frequency input FIN A are used, see programming options for C189 in the Encoder/Frequency Input section).
Set the number of pulse/rev for the encoder being used (parameter C191).
Checking the Reference Sign
If the sign for the reference from encoder is not correct, reverse it by setting C199 =[ FBK XX REF YES ].

# 6. FIRST STARTUP

For the wiring of signals and the power of the inverter, please refer to the Hardware manual.

## 6.1. "IFD" Type Motor Control

SINUS PENTA inverters are factory set with the IFD application software, making it possible to perform the first startup of the drive. The terminal default functions are given in this section. For more details, please check the present Programming Manual.

**1) Wiring:** Follow the instructions stated in sections "Caution Statements" and "Installation".

**2) Power on:** Power on the inverter; the wiring to the **ENABLE** input (terminal 15) is to be open, so that the inverter is disabled.

**3) Parameter alteration:** Access parameter **P000** (Key parameter) and set its code (default value: 00001)and access level **P001** = Eng. Use the ESC, ▲,▼ and SAVE/ENTER keys and move towards the "Submenu Tree" in section 1.2 of the present Programming Manual.

**4) Supply voltage:** Set the real supply voltage for the inverter. You can set either mains voltage range or the DC supply stabilized by a Regenerative Penta inverter. To set the type of power supply for the inverter, access the "Configuration Motor 1" menu and set configuration parameter **C008** to the value corresponding to the installation concerned.

**5) Motor parameters:** Access the "First motor" menu and set ratings as follows:

- **C015** (fmot1) rated frequency
- **C016** (rpmnom1) rated rpm
- **C017** (Pmot1) rated power
- **C018** (Imot1) rated current
- **C019** (Vmot1) rated voltage
- **C029** (Speedmax1) max. allowable speed.

Moreover it is possible to choose the type of V/F pattern setting the parameter **C013** (**C056**, **C099**)
For loads with a quadratic torque with respect to the rpm (centrifugal pumps, fans, etc.) set **C034** (preboost1) to 0%. Press SAVE/ENTER each time a new parameter value is set.

**6) Autotune:** **For this control algorithm the Autotune function is not necessary, but it is always recommended.**

First remove the **ENABLE** command then access the "Autotune Menu" and set **I073** (1: Motor Tune) and **1074** = (0: All Auto no rotation). Use the **ESC** key to accept changes. Close the **ENABLE** command and wait until tune is completed (Warning "**W32** Open Enable" is displayed). The inverter has computed and saved the values for **C022** (stator resistance) and **C023** (leakage inductance). If alarm "**A097** Motor Wires KO" trips, check the motor wiring. If alarm "**A065** Autotune KO" trips, this means that the **ENABLE** command has opened before autotune was complete. In this case, reset the drive sending a command of terminal MDI3, or press the **RESET** key in the display/keypad and repeat the autotune procedure.

**7) Overload:** Set parameters in the "Motor limits 1" submenu depending on the max. desired current.

**8) Startup:** Activate the **ENABLE** input (terminal 15) and the **START** input (terminal 14) and send a speed reference: the RUN LED and REF LED will come on and the motor will start. Make sure the motor is rotating in the correct direction. If not, operate on terminal MDI5 (terminal 18) (CW/CCW) or open the **ENABLE** and **START** terminals. Shut off the inverter, wait at least 5 minutes and reverse two of the motor phases.

**9) Possible failures:**

If no failure occurred, go to step 10. Otherwise, check the inverter connections paying particular attention to supply voltages, DC link and input reference.

Also check if alarm messages are displayed. In the Measure submenu, check the reference speed (**M001**), the supply voltage to the control section (**M030**), the DC link voltage (**M029**), and the condition of control terminals (**M033**). Check to see if these readings match with the measured values.

**10) Additional parameter alterations:**

Note that with parameter **P003** = standby only (condition for altering parameters C) it is possible to alter the **Cxxx** parameters in the CONFIGURATION menu only when the inverter is DISABLED or STOPPED; whilst if **P003** = Standby + Fluxing, it is possible to alter these parameters also with the inverter enabled and the motor stopped.

Before altering any of the parameters, remember that the correct code for parameter **P000** must be set.

It may be a good idea to write down any customised parameter in the table on the last pages of the present Programming Manual.

**11) Reset:**

If an alarm trips, find the cause responsible for the alarm and reset the drive. Enable input MDI3 (terminal 16) for some time, or press the **RESET** on the display/keypad.

## 6.2. "VTC" Type Motor Control

**1) Wiring:** Follow the instructions stated in sections "Caution Statements" and "Installation".

**2) Power on:** Link to terminal **ENABLE** (terminal 15) is to be open when the inverter is started (inverter disabled).

**3)Parameter alteration:** Access parameter **P000** (Key parameter) and set its code (default value: 00001)and access level **P001** = Eng. Use the ESC, ▲, ▼ and SAVE/ENTER keys to access the other parameters. See the paragraph Menu Tree.

**4) Supply voltage:** Set the real supply voltage for the inverter. You can set either the mains voltage range or the DC supply stabilized by a Regenerative Penta inverter. To set the type of power supply for the inverter, access the "Configuration Motor 1" menu and set configuration parameter **C008** to the value corresponding to the installation concerned.

**5) Motor parameters:** Access the "Configuration motor 1" menu and set **C010** (Control Algorithm) as VTC Vector Torque. Set the motor ratings as follows:

- **C015** (fmot1) rated frequency
- **C016** (rpmnom1) rated rpm
- **C017** (Pmot1) rated power
- **C018** (Imot1) rated current
- **C019** (Vmot1) rated voltage
- **C029** (Speedmax1) max. speed desired.

Also set **C022** (resistance of one stator phase for a star connection or one third of one phase resistance for a delta connection) and **C023** (inductance of stator leakage of one phase for a star connection or one third of the leakage of one phase for a delta connection). The **C022** value corresponds to half of the resistance value measured with an ohm-meter between the two phases of the motor. If values to be set for **C022** and **C023** are not known, it is possible to perform parameter autotune (see step 6) or go to step 7. Press SAVE/ENTER each time a new parameter is set.

**6) Autotune:** First remove the **ENABLE** command then access the "Autotune Menu" and set **I073** (1: Motor Tune) and **1074** = (0: All Auto no rotation) . Use the **ESC** key to accept changes. Close the **ENABLE** command and wait until tune is completed (Warning "**W32** Open Enable" is displayed). The inverter has computed and saved the values for **C022** and **C023** . If alarm "**A097** Motor Wires KO" trips, check the motor wiring. If alarm "**A065** Autotune KO" trips, this means that the **ENABLE** command has opened before autotune was complete. In this case, reset the drive sending a command of terminal MDI3, or press the **RESET** key in the display/keypad and repeat the autotune procedure.

**7) Overload:** Set parameter **C048** (Motor 1 Limits submenu) depending on the maximum torque that can be generated expressed as a percentage of the motor rated torque.

**8) Startup:** Activate the **ENABLE** input (terminal 15) and the **START** input (terminal 14) and send a speed reference. The RUN LED and REF LED will come on and the motor will start. Make sure that the motor is rotating in the correct direction. If not, operate on input MDI5 (terminal 18), which is factory-set to CW/CCW, or open the **START** and **ENABLE** inputs. Shut off the inverter, wait at least 5 minutes and reverse two of the motor phases.

**9) Speed regulator adjustment:** If an overshoot occurs when the speed setpoint is reached or if a system instability is detected (uneven motor operation) adjust the parameters relating to the speed loop ("Speed loop and current balancing" submenu). Set the two parameters relating to integral time (**P125, P126**) as [Disabled] and set low values for the parameters relating to proportional gain (**P127, P128**). Set equal values for **P127** and **P128** and increase them until an overshoot takes place when the setpoint is reached. Decrease **P127** and **P128** by approx. 30%, then decrease the high values set for integral time in **P125** and **P126** (keep both values equal) until an acceptable setpoint response is obtained. Check that the motor runs smoothly at constant speed.

**10) Possible failures:** If no failure occurred, go to step 11. Otherwise, check the inverter connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the Motor Measure submenu, check the speed reference (**M000**), the reference speed processed by the ramps (**M002**), the supply voltage of the control section (**M030**), the DC link voltage (**M029**), the condition of the control terminals (**M033**). Check to see if these readings match with the measured values.

**11) Additional parameter alterations:**

Note that with parameter **P003** = standby only (condition for altering parameters C) it is possible to alter the **Cxxx** parameters in the CONFIGURATION menu only when the inverter is DISABLED or STOPPED; whilst if **P003** = Standby + Fluxing, it is possible to alter these parameters also with the inverter enabled and the motor stopped.

Before altering any of the parameters, remember that the correct code for parameter **P000** must be set. It may be a good idea to write down any customised parameter in the table on the last pages of the present Programming Manual.

**12) Reset:**

If an alarm trips, find the cause responsible for the alarm and reset the drive. Enable input MDI3 (terminal 16) for some time, or press the **RESET** on the display/keypad.

## 6.3. "FOC" Type Motor Control

**1) Wiring:** Follow the instructions stated in sections "Caution Statements" and "Installation".

**2) Power on:** Link to terminal **ENABLE** (terminal 15) is to be open when the inverter is started (inverter disabled).

**3) Parameter alteration:** Access parameter **P000** (Key parameter) and set its code (default value: 00001) and access level **P001** = Eng. Use the ESC, ▲, ▼ and SAVE/ENTER keys to access the other parameters. See the paragraph Menu Tree.

**4) Supply voltage:** Set the real supply voltage for the inverter. You can set either the mains voltage range or the DC supply stabilized by a Regenerative Penta inverter. To set the type of power supply for the inverter, access the "Configuration Motor 1" menu and set configuration parameter **C008** to the value corresponding to the installation concerned.

**5) Motor parameters:** Access the "Configuration motor 1" menu and set the motor ratings as follows:

- **C010** (control algorithm) Voltage/frequency
- **C015** (fmot1) rated frequency
- **C016** (rpmnom1) rated rpm
- **C017** (Pmot1) rated power
- **C018** (Imot1) rated current
- **C019** (Vmot1) rated voltage
- **C029** (Speedmax1) max. speed desired.

If the no-load current of the motor is known, in **C021** (**Io**) set the value of **Io** expressed as a percentage of the motor rated current.
If the no-load current of the motor is not known, but the motor can run without load, start the motor at its rated speed, read the current value detected by the inverter (parameter **M026**) in the Motor Measures Menu and use it as the first attempt value for **Io**.
If the no-load current of the motor is not known and the motor cannot run in no-load conditions, use a first attempt value for **Io** that is automatically computed by the inverter, as described in step 7.

NOTE: everytime the autotune, described in step 7, is done with parameter no-load current **C021** (Io) =0, the inverter will set automatically a value according to the motor rating.

Once a no-load current value is entered in **C021**, the value of the parameter relating to mutual inductance (**C024**) will be automatically computed when parameters **I073**= [1: Motor Tune] and **I074**= [1: FOC Auto no rotation] are set up as for current autotune (**C024** is computed even if no autotune procedure occurs).

Also set **C022** (resistance of one stator phase for a star connection or one third of one phase resistance for a delta connection) and **C023** (inductance of stator leakage of one phase for a star connection or one third of the leakage of one phase for a delta connection). The value for **C022** corresponds to half a resistance value measured with an ohm-meter between two of the motor phases. If values for **C022** and **C023** are not known, perform parameter autotune (see step 7) or go to step 6. Press SAVE/ENTER each time a new parameter is set.

**6) Encoder TEST:**

**The motor must be running when testing the encoder.**
Access the Encoder/Frequency Input menu, set the source of the encoder signal used as a speed feedback (Encoder A in terminal board, Encoder B from optional board ES836), enter the number of pulse/rev and the number of the encoder channels (more details are given in the section relating to the Encoder/Frequency Input menu in the present Programming Manual).
In the First Motor menu, set the parameter relating to the speed feedback from encoder: **C012** = Yes.
Access the Autotune menu and set parameter **I073** (select autotune type) as "Encoder Tune", close the **ENABLE** command and wait until encoder tune is complete.
Once encoder tune is complete, the display will show one of the following messages:
1) "**W31** Encoder Ok"; the speed feedback is correct. If the speed detected by the encoder has the opposite signal to that desired by the control, the inverter will automatically invert the feedback signal (parameter **C199** Encoder/frequency Input Menu).
2) "**A59** Encoder Fault"; the speed detected through the encoder is not consistent with the control speed. Possible causes:

- Wrong number of pulse/rev of the encoder
- Wrong power supply of the Encoder (e.g. +5V instead of +24V): check the encoder ratings and the position of jumpers and dip-switches for the encoder supply in the optional encoder board
- Wrong configuration of the dip-switches for the encoder selection (push-pull or line-driver encoder) in the optional encoder board
- No connection to the encoder channel (check wiring)At least one Encoder channel is faulty (replace the encoder).

**7) Autotune of the stator resistance and leakage inductance:**

First remove the **ENABLE** command then access the "Autotune Menu" and set **I073** (1: Motor Tune) and **1074** = (0: All Auto no rotation) . Use the **ESC** key to accept changes. Close the **ENABLE** command and wait until autotune is complete (warning "**W32** Open Enable" is displayed). The inverter has computed and saved the values for **C022** and **C023**. If alarm "**A097** Motor wires KO" trips, check the motor wiring. If alarm "A065 Autotune KO" trips, this means that the **ENABLE** command has opened before autotune was completed. In this case, reset the drive sending a command of terminal MDI3, or press the **RESET** key in the display/keypad and repeat the autotune procedure.

**8) Autotune of the current loop:**

First remove the **ENABLE** command then access the "Autotune Menu" and set **I073** (1: Motor Tune) and **1074** = (0: All Auto no rotation) . Use the **ESC** key to accept changes. Close the **ENABLE** command and wait until autotune is complete (warning "**W32** Open Enable" is displayed). The inverter has computed and saved the values for **P155** and **P156**. If alarm "**A065** Autotune KO" trips, this means that the **ENABLE** command has opened before autotune was completed or that the autotune algorithm failed. In this case, reset the drive sending a command of terminal MDI3, or press the **RESET** key in the display/keypad and repeat the autotune procedure.

**NOTE**: if the **ENABLE** command was not opened before autotune was over, decrease by 5% the no-load current value set in **C021** and repeat the autotune procedure.

**9) Tuning the rotor time constant:**

Rotor time constant (**C025**) is estimated with a special autotune procedure, making it possible for the motor to run even in no-load conditions. If autotune is enabled, first remove the **ENABLE** command then access the "Autotune Menu" and set **I073** (1: Motor Tune) and **1074** = (0: All Auto no rotation) . Use the **ESC** key to accept changes. Close the **ENABLE** command and wait until autotune is over (warning "**W32** Open Enable" is displayed). When autotune is complete, the value obtained for the rotor time constant is automatically saved in parameter **C025**.

If the connected motor can't run without load, the inverter will save automaticly a first attempt value of the motor time constant, according with the motor ratings, during the autotune procedure described in step 7.

**10) Startup:**

Now that all the parameters have been set for the FOC motor control algorithm, access the "First Motor menu" and set the following:

- **C010** (control algorithm) Field Oriented Control

Activate the **ENABLE** input (terminal 15) and the **START** input (terminal 14) and send a speed reference: the RUN LED and REF LED will come on and the motor will start. Make sure the motor is rotating in the correct direction. If not, operate on terminal MDI5 (terminal 18) (CW/CCW) or open the **ENABLE** and **START** terminals. Shut off the inverter, wait at least 5 minutes and reverse two of the motor phases and reverse the encoder reading sign; either reverse the channel signals or access the Encoder/Frequency Input menu and reverse the feedback sign through parameter **C199**.

**11) Speed regulator adjustment:**

If an overshoot occurs when the speed setpoint is reached or if a system instability is detected (uneven motor operation) adjust the parameters relating to the speed loop ("Speed loop and current balancing" submenu). Set the two parameters relating to integral time (**P125, P126**) as [Disabled] and set low values for the parameters relating to proportional gain (**P127, P128**). Set equal values for **P127** and **P128** and increase them until an overshoot takes place when the setpoint is reached. Decrease **P127** and **P128** by approx. 30%, then decrease the high values set for integral time in **P125** and **P126** (keep both values equal) until an acceptable setpoint response is obtained. Check that the motor runs smoothly at constant speed.

**12) Possible failures:**

If alarm "**A060** Fault No Corr." trips, this means that the current loop is not properly tuned. Follow the instructions given in step 8 and decrease the value of I0 (parameter **C021** in the Configuration Motor 1 menu).

If the motor is noisy when starting, this means that the rotor time constant is not correct. Follow the instructions given in step 9 again, or manually change the value of the rotor time constant (parameter **C025**) for a smooth motor startup.

If no failure occurred, go to step 13. Otherwise, check the inverter connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the Motor Measure submenu, check the speed reference (**M000**), the reference speed processed by the ramps (**M002**), the supply voltage of the control section (**M030**), the DC link voltage (**M029**), the condition of the control terminals (**M033**). Check to see if these readings match with the measured values.

**13)Additional parameter alterations:**

For the optimization of the motor performance, adjust parameters **C021** (no-load current), **C024** (mutual inductance), **C025** (rotor time constant). Consider the following:

- **C021** Too high values → Lower torque, specially at rated speed, because most part of the voltage imposed by the inverter is used to magnetize the motor instead of generating a proper motor torque
- **C021** Too low values → Because of the motor flux weakening, higher current ratings are needed
- **C024** Mutual inductance → This is computed each time the no-load current level is altered. This is not binding for the motor control, but strongly affects the correct estimation of the output torque; in case of overestimation, decrease **C025**, and vice versa
- **C025** Optimum value → To obtain the optimum value of the rotor time constant, the best way consists in performing several attempts with a constant load but with different values of **C025**. The optimum value is the one ensuring to obtain the output torque with the lower current (see **M026** in the Motor Measures Menu).

Note that with parameter **P003** = standby only (condition for altering parameters C) it is possible to alter the **Cxxx** parameters in the CONFIGURATION menu only when the inverter is DISABLED or STOPPED; whilst if **P003** = Standby + Fluxing, it is possible to alter these parameters also with the inverter enabled and the motor stopped.

Before altering any of the parameters, remember that the correct code for parameter **P000** must be set.

It may be a good idea to write down any customised parameter in the table on the last pages of the present Programming Manual.

**14) Reset:**

If an alarm trips, find the cause responsible for the alarm and reset the drive. Enable input MDI3 (terminal 16) for some time, or press the **RESET** on the display/keypad.

# 7. MEASURE MENU

## 7.1. Overview

The Measure Menu contains the variables measured by the inverter that can be used by the user.
In the display/keypad, measures are divided into subgroups.
The measure subgroups are the following:

- Motor Measures Menu

This menu contains: the values of the speed reference at constant rpm, the values of the reference being used and the speed values of the connected motor expressed in rpm; the inverter rated frequency;
the torque reference at constant rpm, the torque demand and the motor torque output, the torque limit reference at constant speed and the torque limit being used expressed both in Nm and as a percentage of the rated torque of the selected motor; the flux reference and the electrical variables measured by the inverter mains side, DC bus).

- PID Regulator Menu

This menu contains the values relating to the inverter PID regulator.

- Digital Inputs Menu

This menu contains the state of the inverter digital inputs and indications of the functions programmed on the digital inputs of the inverter.

- References Menu

This menu contains the values of: analog references, the encoder input and the frequency input references, the speed/torque or reference/feedback values of the PID coming from serial link or field bus.

- Outputs Menu

This menu contains the state of the inverter digital outputs, analog outputs and frequency outputs.

- Autodiagnostics Menu

This menu contains temperature values, mains voltage values required for the functioning of Sinus Penta as a regenerative device, and the inverter status.

It also contains the trip log of the last eight alarms tripped and the values of some measures being used when the alarm trip was stored.

It also contains the value of some measures being used when the inverter power was switched off, together with any alarm present at the time.

- Digital Inputs Settings Menu

This menu contains the functions assigned to the digital inputs.

- Trip Log Menu

This menu contains the trip log of the last eight alarms tripped and the values of some measures being used when the alarm trip was stored.

- PowerOff Log Menu

This menu contains the value of some measures being used at the inverter power off.

## 7.2. Motor Measures Menu

This menu contains speed values, torque values and the electrical variables measured by the inverter on the mains side, DC bus and output.

M000 Speed Reference at Constant rpm

| | | | |
|---|---|---|---|
| M000-1 | Range | ± 32000 (integer part) ± 99 (decimal part) | ± 32000.99 rpm<br>Note: The actual range depends on the selected motor, because it is defined by the value set in the parameters for the motor max. speed and min. speed.<br>C028–C029 Motor 1<br>C071–C072 Motor 2<br>C114–C115 Motor 3 |
| | Active | Active only when a speed reference is used for the selected motor. | |
| | Address | 1650 (integer part) 1651 (decimal part) | |
| | Function | Value of the speed reference obtained when the motor rotates at constant speed, once the preset ramp time is over. | |

M002 Speed Ramp Output

| | | | |
|---|---|---|---|
| M002-3 | Range | ± 32000 (integer part) ± 99 (decimal part) | ± 32000.99 rpm<br>Note: The actual range depends on the selected motor, because it is defined by the value set in the parameters for the motor max. speed and min. speed.<br>C028–C029 Motor 1<br>C071–C072 Motor 2<br>C114–C115 Motor 3 |
| | Active | Active only when a speed reference is used for the selected motor. | |
| | Address | 1652 (integer part) 1653 (decimal part) | |
| | Function | This is the measure of the speed value processed with respect to the ramp time. | |

M004 Motor Speed

| | | | |
|---|---|---|---|
| M004-5 | Range | ± 32000 (integer part) ± 99 (decimal part) | ± 32000.99 rpm |
| | Active | Always active. | |
| | Address | 1654 (integer part) 1653 (decimal part) | |
| | Function | Motor speed value. | |

M006 Inverter Output Frequency

| | | | |
|---|---|---|---|
| M006 | Range | ± 10000 | ± 1000.0 Hz (see Table 41) |
| | Active | Always active. | |
| | Address | 1656 | |
| | Function | This is the measure of the voltage frequency output of the inverter. | |

### M007 Torque Reference at Constant Speed Nm

| | | | |
|---|---|---|---|
| M007 | Range | ± 3200 | ± 3200 Nm<br>Note: The actual range depends on the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active only when a torque reference is used for the selected motor. | |
| | Address | 1660 | |
| | Function | This is the measure of the torque reference required at constant speed and expressed as a percentage of the motor rated torque. | |

### M008 Torque Demand (Nm)

| | | | |
|---|---|---|---|
| M008 | Range | ± 32000 | ± 32000 Nm<br>Note: The actual range depends on the rated torque and the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1658 | |
| | Function | With speed control: Torque demand of the speed regulator for the type of control used.<br>With torque control: Torque reference processed with respect to the preset torque ramp time. | |

### M009 Torque Generated by the Motor (Nm)

| | | | |
|---|---|---|---|
| M009 | Range | ± 32000 | ± 32000 Nm |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1659 | |
| | Function | Approximate value of the torque produced by the connected motor. | |

### M010 Torque Reference at Constant Rpm (%)

| | | | |
|---|---|---|---|
| M010 | Range | ± 500 | ± 500 %<br>Note: The actual range depends on the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active only when a torque reference is used for the selected motor. | |
| | Address | 1660 | |
| | Function | This is the measure of the torque reference required at constant speed and expressed as a percentage of the motor rated torque. | |

M011 Torque Demand (%)

| | | | |
|---|---|---|---|
| M011 | Range | ± 500 | ± 500 %<br>Note: The actual range depends on the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1661 | |
| | Function | With speed control: Torque demand of the speed regulator expressed as a percentage of the motor rated torque.<br>With torque control: Torque reference processed with respect to the preset torque ramp time and expressed as a reference of the motor rated torque. | |

M012 Torque Generated by the Motor (%)

| | | | |
|---|---|---|---|
| M012 | Range | ± 500 | ± 500% |
| | Active | Active only for VTC and FOC controls. | |
| | Address | 1662 | |
| | Function | Approximate value of the torque produced by the motor and expressed as a percentage of the rated torque of the selected motor. | |

M013 Torque Limit Demand before Ramps (Nm)

| | | | |
|---|---|---|---|
| M013 | Range | ± 32000 | ± 32000 Nm<br>Note: The actual range depends on the preset torque limit values and the rated torque of the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1663 | |
| | Function | This is the limit value for the torque at constant speed. If an external torque limit is used, the value of this measure is the torque limit obtained at constant speed; on the other hand, if the torque limit is internal to the inverter, this value is the actual torque limit expressed in Nm. | |

M014 Torque Limit Demand after Ramps (Nm)

| | | | |
|---|---|---|---|
| M014 | Range | ± 32000 | ± 32000 Nm<br>Note: The actual range depends on the preset torque limit values and the rated torque of the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1664 | |
| | Function | This is the torque limit value being used, expressed in Nm. | |

## M015 Torque Limit Reference before ramps (%)

| | | | |
|---|---|---|---|
| M015 | Range | ± 500 | ± 500 %<br>Note: The actual range depends on the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1665 | |
| | Function | This is the limit value for the torque at constant speed expressed as a percentage of the rated torque of the selected motor. If an external torque limit is used, the value of this measure is the torque limit obtained at constant speed; on the other hand, if the torque limit is internal to the inverter, this value is the actual torque limit. | |

## M016 Torque Limit Reference after ramps (%)

| | | | |
|---|---|---|---|
| M016 | Range | ± 500 | ± 500 %<br>Note: The actual range depends on the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1666 | |
| | Function | This is the torque limit value being used expressed as a percentage of the motor rated torque. | |

## M017 Flux Reference

| | | | |
|---|---|---|---|
| M017 | Range | 0 ÷ 500 | 0 ÷ 5.00 Wb |
| | Active | Active for VTC and FOC controls only. | |
| | Address | 1667 | |
| | Function | Flux reference required and expressed in Weber (Wb). | |

## M026 Output Current

| | | | |
|---|---|---|---|
| M026 | Range | 0÷65535 | 0÷6553.5 A<br>Note: The actual range depends on the inverter size. |
| | Active | Always active. | |
| | Address | 1676 | |
| | Function | Measure of the RMS of the output current. | |

## M027 Output Voltage

| | | | |
|---|---|---|---|
| M027 | Range | 0÷65535 | 0÷65535 V<br>Note: The actual range depends on the inverter voltage class. |
| | Active | Always active. | |
| | Address | 1677 | |
| | Function | Measure of the RMS of the output voltage. | |

M028 Output Power

| | | | |
|---|---|---|---|
| M028 | Range | 0÷65535 | 0÷6553.5 kW<br>Note: The actual range depends on the inverter size. |
| | Active | Always active. | |
| | Address | 1678 | |
| | Function | Measure of the active power produced by the inverter. | |

M029 DC-Bus Voltage

| | | | |
|---|---|---|---|
| M029 | Range | 0÷1400 | 0÷1400 V |
| | Active | Always active. | |
| | Address | 1679 | |
| | Function | Measure of the voltage in the inverter DC-link. | |

M030 Supply Voltage

| | | | |
|---|---|---|---|
| M030 | Range | 0÷1000 | 0÷1000 V |
| | Active | Always active. | |
| | Address | 1680 | |
| | Function | Measure of the effective value of the inverter supply voltage. | |

## 7.3. PID Regulator Menu

This menu contains the measures relating to the input and output values of the internal PID regulator.

M018 PID Reference at constant rpm (%)

| | | | |
|---|---|---|---|
| M018 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the max. value and the min. value of the PID reference set in the following parameters:<br>**P245–P246** |
| | Active | Always active. | |
| | Address | 1668 | |
| | Function | This is the measure of the PID reference expressed as a percentage. Please refer to the **PID Parameters and PID Configuration Menus** for the scaling of the PID input. | |

M019 PId Reference after ramps (%)

| | | | |
|---|---|---|---|
| M019 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the max. value and the min. value of the PID reference set in the following parameters:<br>**P245–P246** |
| | Active | Always active. | |
| | Address | 1669 | |
| | Function | This is the measure of the PID reference expressed as a percentage. Please refer to the **PID Parameters and PID Configuration Menus** for the scaling of the PID input. | |

M020 PID Feedback (%)

| | | | |
|---|---|---|---|
| M020 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the max. value and the min. value of the PID feedback set in the following parameters:<br>**P247–P248** |
| | Active | Always active. | |
| | Address | 1670 | |
| | Function | This is the measure of the PID feedback expressed as a percentage. Please refer to the **PID Parameters and PID Configuration Menus** for the feedback scaling of the PID input. | |

M021 PID Error (%)

| | | | |
|---|---|---|---|
| M021 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the min. and max. saturation values of the reference and the feedback set in the following parameters:<br>**P245–P246** (reference)<br>**P247–P248** (feedback) |
| | Active | Always active. | |
| | Address | 1671 | |
| | Function | This is the measure of the PID input error expressed as a percentage.<br>See also the PID PARAMETERS MENU and the PID CONFIGURATION MENU. | |

M022 PID Output (%)

| | | | |
|---|---|---|---|
| M022 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the min. and max. saturation values of the PID output set in the following parameters: **P236–P237**. |
| | Active | Always active. | |
| | Address | 1672 | |
| | Function | This is the measure of the output produced by the PID regulator and expressed as a percentage. Please refer to the **PID Parameters** and **PID Configuration Menus** for the scaling of the PID output. | |

M023 PID Reference after ramps

| | | | |
|---|---|---|---|
| M023 | Range | ±32000 | Note: The actual range depends on the max. value and the min. value of the PID reference set in parameters **P245–P246** and on the gain level set in **P257**. |
| | Active | Always active. | |
| | Address | 1673 | |
| | Function | This is the measure of the reference being used for the PID regulator, as **M019** but multiplied by the gain level set in **P257** (see also the PID PARAMETERS MENU and the PID CONFIGURATION MENU). For the display/keypad, the unit of measure can be programmed with the parameters **P267**, **P267a** in the **Display/Keypad Menu.** | |

M024 PID Feedback

| | | | |
|---|---|---|---|
| M024 | Range | ±32000 | Note: The actual range depends on the max. value and the min. value of the PID feedback set in parameters **P247–P248** and on the gain level set in **P257**. |
| | Active | Always on. | |
| | Address | 1674 | |
| | Function | This is the measure of the feedback being used for the PID regulator, as **M020** but multiplied by the gain level set in **P257** (see also the PID PARAMETERS MENU and the PID CONFIGURATION MENU). For the display/keypad, the unit of measure can be programmed with the parameters **P267**, **P267a** in the **Display/Keypad Menu.** | |

## 7.4. Digital Inputs Menu

In this submenu, it is possible to check the state of the command sources for the digital inputs (local terminals, serial link and field bus), the terminal board resulting from their combination and the terminals which are actually used for the inverter control. The terminals which are actually used to control the inverter also consider any timers applied to the digital inputs.

M031 Delayed Digital inputs

| | | | |
|---|---|---|---|
| M031 | Range | Bit-controlled measure | *Table 1: Codification of measures **M031**, **M032**. |
| | Active | Always active. | |
| | Address | 1681 | |
| | Function | State of the virtual control terminal board used by the inverter. This is the terminal board resulting from the combination of the preset command sources (local terminal board, serial link and field bus), where the **ENABLE** command is given by the AND of all the **ENABLE** commands; for the other inputs, the OR command between the different command sources is applicable. See also the CONTROL METHOD MENU and the TIMERS MENU. | |

M032 Instant Digital Inputs

| | | | |
|---|---|---|---|
| M032 | Range | Bit-controlled measure | *Table 1: Codification of measures **M031**, **M032**. |
| | Active | Always active. | |
| | Address | 1682 | |
| | Function | State of the virtual control terminal board before application of the timers to the digital inputs (if no timer is applied, it matches with M031). This is the terminal board resulting from the combination of the preset command sources (local terminal board, serial link and field bus), where the **ENABLE** command is given by the AND of all the **ENABLE** commands; for the other inputs, the OR command between the different command sources is applicable. See also the CONTROL METHOD MENU. | |

Table 1: Codification of Measures M031, M032.

| Bit n. | Digital Input | Bit n. | Digital Input |
|---|---|---|---|
| 0 | MDI1(START) | 5 | MDI6/ECHA/FINA |
| 1 | MDI2(ENABLE) | 6 | MDI7/ECHB |
| 2 | MDI3(RESET) | 7 | MDI8/FINB |
| 3 | MDI4 | 8 | ENABLE S |
| 4 | MDI5 | 9 | ENABLE |

M033 Local Control Terminal Board

| | | | |
|---|---|---|---|
| M033 | Range | Bit-controlled measure | *Table 2: Codification of measures **M033**, **M034**, **M035**. |
| | Active | Always active. | |
| | Address | 1683 | |
| | Function | State of the digital inputs in the inverter terminal board. | |

M034 Control Terminals from Serial Link

| | | | |
|---|---|---|---|
| M034 | Range | Bit-controlled measure | *Table 2: Codification of measures **M033**, **M034**, **M035**. |
| | Active | Always active. | |
| | Address | 1684 | |
| | Function | State of the digital inputs in the terminal board controlled via serial link. | |

M035 Control Terminal Board from Field Bus

| | | | |
|---|---|---|---|
| M035 | Range | Bit-controlled measure | *Table 2: Codification of measures **M033**, **M034**, **M035**. |
| | Active | Always active. | |
| | Address | 1685 | |
| | Function | State of the digital inputs in the terminal board controlled from field bus. | |

**Table 2: Codification of Measures M033, M034, M035 .**

| Bit n. | Digital Input | Bit n. | Digital Input |
|---|---|---|---|
| 0 | MDI1(START) | 4 | MDI5 |
| 1 | MDI2(ENABLE) | 5 | MDI6/ECHA/FINA |
| 2 | MDI3(RESET) | 6 | MDI7/ECHB |
| 3 | MDI4 | 7 | MDI8/FINB |

## 7.5. References Menu

This menu contains the measures of the possible reference sources for speed, torque or PID available in the terminal board (analog inputs, frequency inputs and encoder input) and from serial link or field bus.

M037 External Analog Reference REF

| | | | |
|---|---|---|---|
| M037 | Range | Function of the preset type of reference (voltage/current) | Function of the type of reference (voltage/current) set in **P050**. The numerical value always includes two decimal figures; the unit of measure is V or mA. |
| | Active | Always active. | |
| | Address | 1687 | |
| | Function | Measure of the voltage /current value detected by the inverter in analog input REF. | |

M038 External Analog Reference AIN1

| | | | |
|---|---|---|---|
| M038 | Range | Function of the preset type of reference (voltage/current) | Function of the type of reference (voltage/current) set in **P055**. The numerical value always includes two decimal figures; the unit of measure is V or mA. |
| | Active | Always active. | |
| | Address | 1688 | |
| | Function | Measure of the voltage /current value detected by the inverter in analog input AIN1. | |

M039 External Analog Reference AIN2

| | | | |
|---|---|---|---|
| M039 | Range | Function of the preset type of reference (voltage/current) | Function of the type of reference (voltage/current) set in **P060**. The numerical value always includes two decimals; the unit of measure is V or mA. |
| | Active | Always active. | |
| | Address | 1689 | |
| | Function | Measure of the voltage /current value detected by the inverter in analog input AIN2. | |

M040 Speed Reference from Serial Link

| | | | |
|---|---|---|---|
| M040 | Range | ± 32000 (integer part)<br>± 99 (decimal part) | ± 32000.99 rpm<br>Note: The actual range depends on the selected motor, because it is determined by the values set for the min. speed and max. speed parameters of the selected motor.<br>**C028**–**C029** Motor 1<br>**C072**–**C073** Motor 2<br>**C114**–**C115** Motor 3 |
| | Active | Always active. | |
| | Address | 1690 (integer part) 1691 (decimal part) | |
| | Function | This is the value of the speed reference set via serial link. | |

## M042 Speed Reference from Field Bus

| | | | |
|---|---|---|---|
| M042 | Range | ± 32000 (integer part) ± 99 (decimal part) | ± 32000.99 rpm<br>Note: The actual range depends on the selected motor, because it is defined by the value set in the parameters for the motor max. speed and min. speed.<br>**C028–C029** Motor 1<br>**C072–C073** Motor 2<br>**C114–C115** Motor 3 |
| | Active | Always active. | |
| | Address | 1692 (integer part) 1693 (decimal part) | |
| | Function | This is the measure of the speed reference set by the field bus. | |

## M044 Torque Reference from Serial Link

| | | | |
|---|---|---|---|
| M044 | Range | ± 5000 | ± 500.0 %<br>Note: The actual range depends on the torque limit value set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Always active. | |
| | Address | 1694 | |
| | Function | This is the measure of the torque reference set via serial link and expressed as a percentage of the rated torque of the selected motor. | |

## M045 Torque Reference from Field Bus

| | | | |
|---|---|---|---|
| M045 | Range | ± 5000 | ± 500.0 %<br>Note: The actual range depends on the torque limit values set for the selected motor.<br>**C047–C048** Motor 1<br>**C090–C091** Motor 2<br>**C133–C134** Motor 3 |
| | Active | Always active. | |
| | Address | 1695 | |
| | Function | This is the measure of the torque reference set by the field bus and expressed as a percentage of the rated torque of the selected motor. | |

## M046 PID Reference from Serial Link

| | | | |
|---|---|---|---|
| M046 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the min. value and the max. value of the PID reference set in parameters:<br>**P245–P246** |
| | Active | Always active. | |
| | Address | 1696 | |
| | Function | This is the measure of the PID reference set via serial link and expressed as a percentage. | |

### M047 PID Reference from Field Bus

| | | | |
|---|---|---|---|
| M047 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the min. value and the max. value of the PID reference set in parameters:<br>**P245–P246** |
| | Active | Always active. | |
| | Address | 1697 | |
| | Function | This is the measure of the PID reference set by the field bus and expressed as a percentage. | |

### M048 PID Feedback from Serial Link

| | | | |
|---|---|---|---|
| M048 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the min. value and the max. value of the PID feedback set in parameters:<br>**P247–P248** |
| | Active | Always active. | |
| | Address | 1698 | |
| | Function | This is the measure of the PID feedback set via serial link and expressed as a percentage. | |

### M049 PID Feedback from Field Bus

| | | | |
|---|---|---|---|
| M049 | Range | ±10000 | ±100.00 %<br>Note: The actual range depends on the min. value and the max. value of the PID feedback set in parameters:<br>**P247–P248** |
| | Active | Always active. | |
| | Address | 1699 | |
| | Function | This is the measure of the PID feedback set via field bus and expressed as a percentage. | |

### M050 Encoder Reference

| | | | |
|---|---|---|---|
| M050 | Range | ± 32000 | ± 32000 rpm. |
| | Active | Always active. | |
| | Address | 1700 | |
| | Function | Reading of the encoder set as a reference source (see the ENCODER/FREQUENCY INPUTS MENU and the CONTROL METHOD MENU). | |

### M051 Frequency Input Reference

| | | | |
|---|---|---|---|
| M051 | Range | 1000 ÷ 10000 | 10000 ÷ 100000 Hz.<br><br>Note: The actual range depends on the frequency min. value and max. value set in **P071-P072**. |
| | Active | Always active. | |
| | Address | 1701 | |
| | Function | Frequency read in the digital input set as a reference source (see the ENCODER/FREQUENCY INPUTS MENU and the CONTROL METHOD MENU). | |

## 7.6. Digital Outputs Menu

In this menu it is possible check the state of the digital outputs, the analog outputs and the frequency outputs available in the terminal board.

M056 Digital Outputs

| M056 | Range | Bit-controlled measure | *See Table 3. |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1706 | |
| | Function | State of digital inputs MDO1÷4. | |

Table 3: Codification of Measure M056

| Bit n. | Digital Output |
|---|---|
| 0 | MDO1/FOUT |
| 1 | MDO2 |
| 2 | MDO3 |
| 3 | MDO4 |

M057 Frequency Output

| M057 | Range | 10000÷100000 | 10000 ÷ 100000 Hz<br>Note: The actual range depends on the min. value and the max. value of digital output MDO1 set as a frequency reference. Values are set in **P204** and **P205** (see ANALOG AND FREQUENCY OUTPUTS MENU). |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1707 | |
| | Function | This is the frequency measure produced by digital output MDO1 used as a frequency output. | |

M058 Analog Output AO1

| M058 | Range | ±100 | ±100 % |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1708 | |
| | Function | Value percent of analog output AO1, referred to the preset max. output value (maximum absolute value between **P182** and **P183**, see ANALOG AND FREQUENCY OUTPUTS MENU). | |

M059 Analog Output AO2

| M059 | Range | ±100 | ±100 % |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1709 | |
| | Function | Value percent of analog output AO2 referred to the preset max. output value (maximum absolute value between **P190** and **P191**, see ANALOG AND FREQUENCY OUTPUTS MENU). | |

M060 Analog Output AO3

| M060 | Range | ±100 | ±100 % |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1710 | |
| | Function | Value percent of analog output AO3 referred to the preset max. output value (maximum absolute value between **P198** and **P199**, see ANALOG AND FREQUENCY OUTPUTS MENU). | |

## 7.7. Autodiagnostics Menu

In this menu it is possible to check the reading of the analog channels used for temperature sensors and the relevant temperature values.

M062 Ambient temperature Measure

| M062 | Range | ± 32000 | ± 320.0 °C |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1711 | |
| | Function | Ambient temperature measured on the surface of the control board. | |

M064 IGBT Temperature Measure

| M064 | Range | ± 32000 | ± 320.0 °C |
|---|---|---|---|
| | Active | Always active. | |
| | Address | 1714 | |
| | Function | Measure of the temperature in IGBTs.<br>Note: Not all inverter sizes are provided with this sensor. | |

M089 Inverter State

| M089 | Range | See Table 86 |
|---|---|---|
| | Active | Always active. |
| | Address | 1739 |
| | Function | Describes the current condition of the inverter. |

M090 Active Alarm

| M090 | Range | See Table 84 |
|---|---|---|
| | Active | Always active |
| | Address | 1740 |
| | Function | Alarm tripped. |

## 7.8. Digital Inputs Settings Menu

In this submenu it is possible to check the functions assigned to the digital inputs.

**Table 4: Codification of the Functions Assigned to the Digital Inputs.**

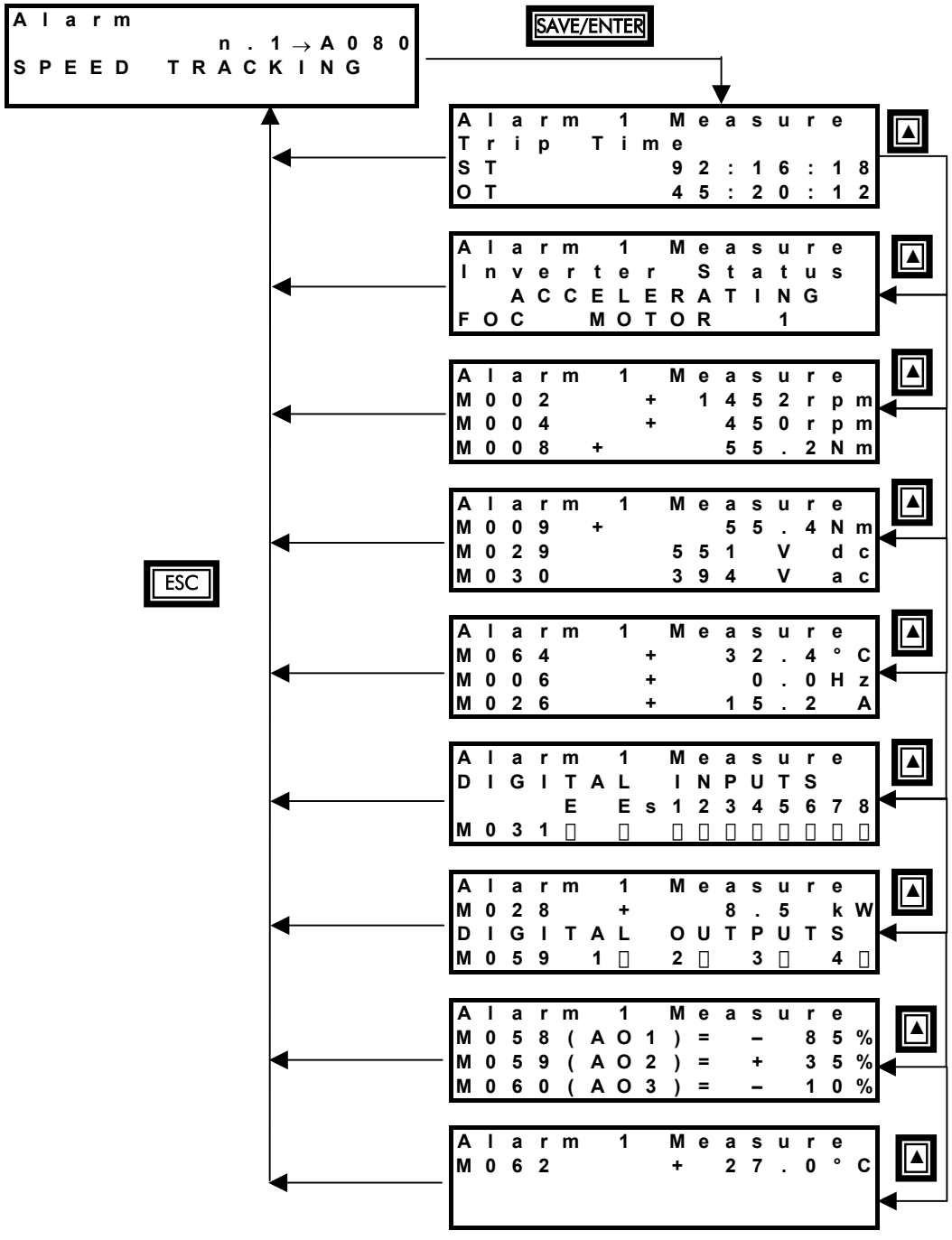
| Display Items | Function Assigned to the Digital Inputs |
|---|---|
| STOP | Stop function |
| REVERSE | Startup with negative speed |
| EN–S | ENABLE in safety condition |
| DISABLE | Inverter disabling |
| MVel0 | Multispeed 0 |
| MVel1 | Multispeed 1 |
| MVel2 | Multispeed 2 |
| MVel3 | Multispeed 3 |
| Cw/CCw | Reversal of the direction of rotation |
| DCB | DC Braking |
| UP | Reference increase |
| DOWN | Reference decrease |
| UDReset | Reset of speed setpoint due to UP/DOWN command |
| Alarm 1 | Auxiliary trip 1 |
| Alarm 2 | Auxiliary trip 2 |
| Alarm 3 | Auxiliary trip 3 |
| MRmp0 | Multiramp 0 |
| MRmp1 | Multiramp 1 |
| JOG | Jog mode |
| SLAVE | Selection of Slave Mode |
| PID Dis | PID Disabling |
| KpdLock | Display/keypad unit |
| Mot 2 | Selection of Motor 2 |
| Mot 3 | Selection of Motor 3 |
| Var 0 | Reference Variation 0 |
| Var 1 | Reference Variation 1 |
| Var 2 | Reference Variation 2 |
| PID UDR | PID Reference Reset due to UP/DOWN commands |
| LOCAL | Selection of Local mode |
| Brk Lock | Mechanical Brake locking |
| FireM | Fire Mode Enabled |
| Src. Sel | Reference/command source switch |
| nTlim | Disable external torque limit |
| START | START Function |
| ENABLE | ENABLE |
| RESET | Alarm reset |
| EncA | Encoder A Input |
| EncB | Encoder B Input |
| FinA | Frequency input FINA |
| FinB | Frequency input FINB |
| Multi | More than one function programmed on the same input |

## 7.9. Trip Log Menu (Fault List)

Scroll the **Trip Log Menu** to display the codes of the last eight alarms tripped.

Press the **SAVE/ENTER** key to access the alarm submenu and navigate to each value measured by the inverter when the alarm tripped.
The next page shows a navigation example for the **Trip Log Menu** (relating to alarm n.1 in particular). Note that n.1 is the last alarm tripped and n.8 is the first alarm tripped.
The measures marked with **Mxxx** are the same measures used in this section.

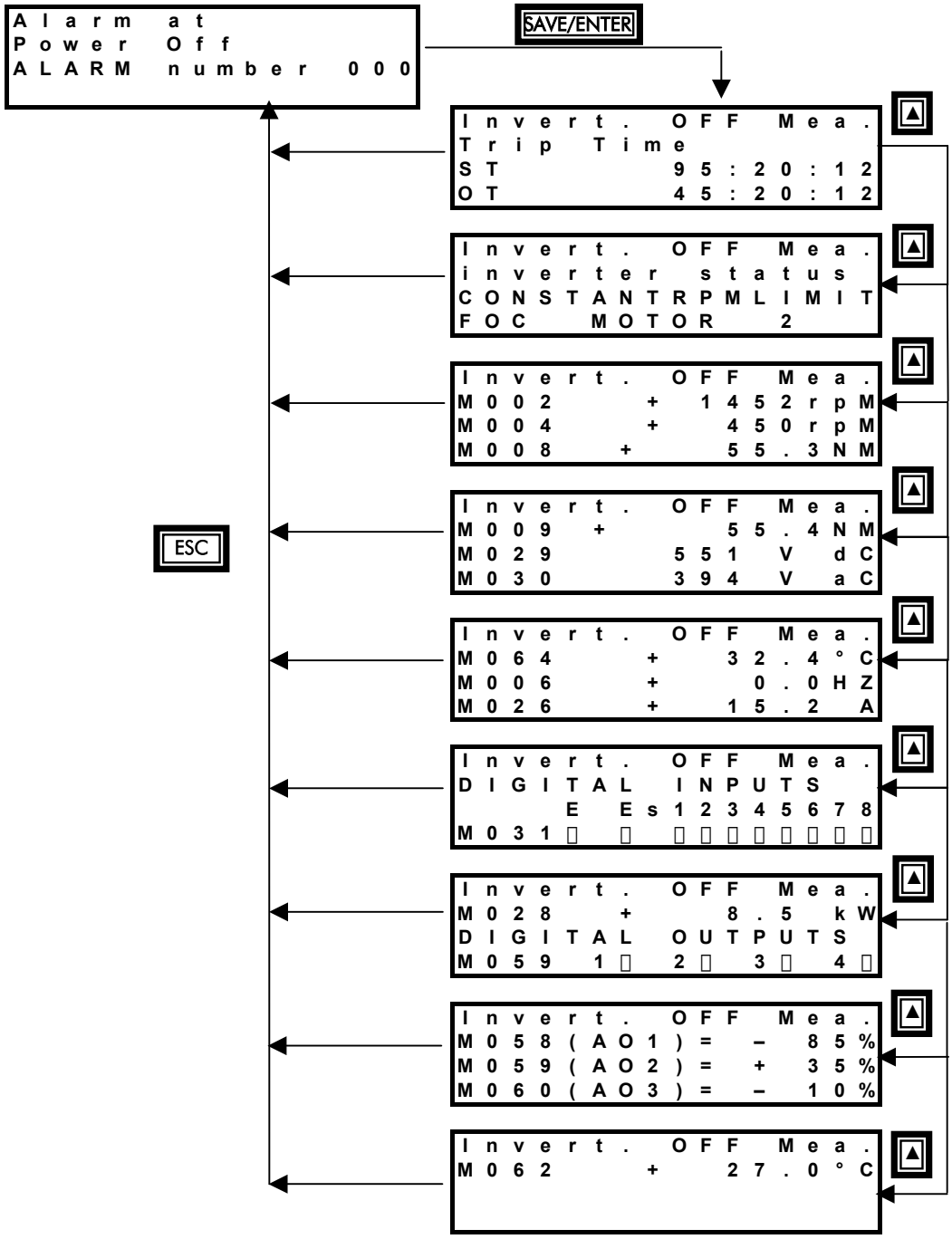
**Example of navigation in the Trip Log Menu.**



## 7.10. PowerOff Log Menu (Power Off List)

This submenu contains the measures of some characteristic variables detected at the inverter power off, in conjunction with the alarm (if any) tripped at that moment.
Press the **SAVE/ENTER** key to access the submenu and navigate to the measures detected by the inverter when it was tripped. Measures and codes are the same as the ones shown in the **Trip Log Menu (Fault List)**.
The next page shows a navigation example for the **PowerOff Log Menu (Power Off List)**.

**Navigation Example – PowerOff Log Menu**



# 8. PRODUCT MENU

## 8.1. Overview

In the product menu the **P263 Language** parameter used in the keyboard/display appears as well as information relative to the product, such as:

- Product Name (read-only)
- Type (read-only)
- Application (read-only)
- SW versions (read-only)
- Inverter service times (read-only)
- Serial Number (read-only)
- Fire Mode enable Password (read/write)
- Manufacturer (read-only)

## 8.2. P263 Parameters and Fire Mode enable Password

Table 5: List of Parameter P263 ÷ Fire Mode enable Password

| Parameter | FUNCTION | Access Level | DEFAULT VALUE | MODBUS address |
|---|---|---|---|---|
| P263 | Language | BASIC | 0[:Italiano]<br>1:[English] (for English Countries) | 863 |
| | Fire Mode enable Password | BASIC | 0 | 868 |

P263 Language

| | | | |
|---|---|---|---|
| **P263** | **Range** | 0 ÷ 4 | 0: ITALIANO<br>1: ENGLISH<br>2: ESPANOL<br>3: PORTUGUES<br>4: DEUTSCH |
| | **Default** | 0 | 0: ITALIANO *(for English Countries 1:[English])* |
| | **Level** | BASIC | |
| | **Address** | 863 | |
| | **Function** | With the factory setting the language used on the keyboard/display is Italian, by using the **P263** parameter it is possible to change the setting. The man/machine keypad interface software is known as MMI (man/machine interface) and its version is displayed on the SW versions screen of the product menu. | |

CAUTION **It is also possible to use the extended version of the MMI software containing languages different from the ones mentioned above.**

Product Name and Type

| | | |
|---|---|---|
| **Product Name and Type** | **Function** | This screen displays the product name and type (see example below) . |

```
Product name
PENTA
type  0020  4T  _
```

The product name appears on the second line of the keyboard/display. The third line shows the voltage class and the size of the inverter and the type of fan management. In the case shown in the example, the voltage class is 4T (400V), the size of the inverter is 0020 and the control board ES821 does not manage the fan functioning (condition identified by the character _ ).

The possible characters found in the third field of the third line have the following meaning:

- _ : Fans not managed by the ES821 board
- S : The ES821 control board only contains the information concerning the correct functioning of the fans: if a fan failure is detected the corresponding alarm will go off.
- P : Activation of the fans managed by the state of the thermoswitch detected by the control board.
- N : An NTC temperature sensor manages the functioning of the fans, the temperature is measured by the ES821 board and the fan threshold activation is defined by parameter **C264**.

## Application

| Application | Function | This screen displays the type of application uploaded on the inverter (e.g. Multi pump, Regenerative, etc...).<br>See the Elettronica Santerno Software Accessories Catalogue.<br>For the application software downloading instructions see the Applications Manual. |
|---|---|---|

## SW Versions

| SW versions | Function | This screen displays the SW versions programmed on the inverter.<br>Texas → SW version of the DSP Texas module<br>MMI → SW version of the display/keyboard man machine interface<br>Motorola → SW version of the Motorola microprocessor |
|---|---|---|

## Service Times

| Service times | Function | This screen displays the ST (supply time) activation times and the OT (operation time).<br>Operation time means the activation time of the inverter's IGBT. |
|---|---|---|

Service times screen:

```
Supply Time
ST  =  53:25:01
Operation Time
OT  =  29:35:51
```

Serial Number

| Serial Number | Function | The serial number of the inverter. |
|---|---|---|
| | | |

Fire Mode enabling Password

| Fire Mode enabling Password | Function | To gain access to the Fire Mode enabling password , contact Elettronica Santerno customer service with the Serial Number of the inverter which the Fire Mode activation mode is to be used on and type in the password given. |
|---|---|---|
| | | |

Manufacturer

| Manufacturer | Function | The name Elettronica Santerno is displayed together with the corresponding website. |
|---|---|---|
| | | |

# 9. PASSWORD AND ACCESS LEVEL MENU

## 9.1. Overview

The Password and Access Level menu contains the parameters concerning the possibility to modify and view the parameters.

- **P000** for enabling parameter modification
- **P001** the user access level
- **P002** allows the modification of the **P000** password value
- **P003** parameter C modification conditions

## 9.2. List of Parameters from P000 to P003

**Table 6: List of Parameters P000 ÷ P003**

| Parameter | FUNCTION | Access Level | DEFAULT VALUE | MODBUS Address |
|---|---|---|---|---|
| P000 | Writing Enabling | BASIC | 00001 | 864 |
| P001 | Programming level | BASIC | 0:[Basic] | 865 |
| P002 | Writing enabling password | ENGINEERING | 00001 | 512 |
| P003 | Parameter C modification condition | ADVANCED | StandBy+Fluxing | 866 |

**P000: Writing Enabling**

The writing of the parameters is enabled as default programming, **P000 = 1**. Access is gained to the **P000** parameter that enables the writing of the parameters by entering in the Password Menu and in the Access Level in the Parameters Menu.

| P000 | | | |
|---|---|---|---|
| | Range | 00000÷32767 | 00000: [No] ÷32767 |
| | Default | 1 | 1 |
| | Level | BASIC | |
| | Address | Not accessible via the serial link.<br>The writing of the parameters from the serial link is always enabled. | |
| | Function | Setting the correct value in the **P000** enables the parameters to be modified.<br>The **P000** default password is 00001.<br>The password for modifying the parameters can be personalised by setting the new password in **P002.** | |

P001: User Level

| | | | |
|---|---|---|---|
| P001 | Range | 0÷3 | 0: Basic<br>1: Advanced<br>2: Engineering |
| | Default | 0 | 0 : Basic |
| | Level | BASIC | |
| | Address | 514 | |
| | Function | The programming parameters of the inverter are divided into access levels according to the complexity of the functions.<br>Depending on the user level set in the display/keyboard the visibility of some menus or parts of them on the part of the user is modified.<br>Therefore, if a BASIC user level is set, once the inverter is properly parameterised, navigation is easier because the user can view a more limited set of parameters, including only those parameters requiring more frequent modifications.<br>**Every Parameter in the Manual is displayed in the Level field and the relative user level is highlighted.** | |

P002 Password for Writing Enabling

| | | | |
|---|---|---|---|
| P002 | Range | 00001 ÷ 32767 | 00001 ÷ 32767 |
| | Default | 00001. | |
| | Level | ENGINEERING | |
| | Address | 867 | |
| | Function | Once the password has been typed into **P000** and writing enabling has been gained, the setting may be personalised by means of this parameter. | |

CAUTION

Once a setting has been typed into **P002** that is different from the default setting, the password for access to writing of the **P000** parameters to be used is the setting in **P002**.
It is strongly advised to take note and conserve the password!

P003 Condition for modifying the C parameters

| | | | |
|---|---|---|---|
| P003 | Range | 0 ÷ 1 | 0:[Only on stand by] ÷ 1:[StandBy+Fluxing] |
| | Default | 1: [StandBy+Fluxing] | |
| | Level | ADVANCED | |
| | Address | 509 | |
| | Function | The type C parameters with the factory settings may be only programmed when the motor is stopped, by setting **P003=0: [Only on stand by]**<br>it is possible to modify them when the inverter is disabled | |

CAUTION

With **P003 = 1:[StandBy+Fluxing]** when a type C parameter has to be modified the inverter is automatically disabled and it stops modulating and the motor is left idle.

# 10. DISPLAY/KEYPAD MENU

## 10.1. Overview

NOTE

It is important to read the "Operating and Remoting the Keypad" section in the Sinus Penta Installation Manual.

The Display/Keypad Menu contains the parameters for the programming of:

- navigating in the inverter menus;
- selecting the startup page;
- selecting the measures of the root page and the keypad page;
- the type of keypad page displayed in the local mode;
- the customised PID unit of measures;
- disabling the LOC/REM or Fwd/Rew keys in the keypad.

To follow is an outline of the Root Page, the Keypad and the Local Mode page.

## 10.2. The Root Page

```
   I N V E R T E R    O K
→        +   1 5 0 0 . 0 0 r p m
→        +         0 . 0 0 r p m
   M E A   P A R   C F [ I D P ]
```

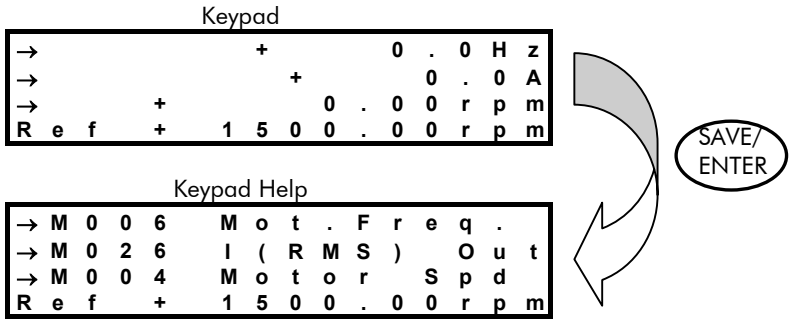
The Root page is factory-set as the startup page to be displayed when the inverter is turned on.

NOTE

Only from this page, you can access the four main menus available:
MEA → measures;
PAR → programming parameters;
CF → configuration parameters;
IDP → product identification.

The startup line of this page displays the inverter operating status (see the M089 description) .
The second and third lines display two measures which may be selected with the parameters P268, P268a.
The fourth line displays four main menus of the inverter. The menu selected is the one displayed in the square brackets: to change the selection use the ▲ and ▼ keys; to access the menu press the SAVE/ENTER key.

## 10.3. Keypad and Local Mode Page




Access to the keypad pages can be gained only by pressing the **MENU key** from the Root Page or by entering the local mode by pressing the **LOC/REM key**.

The measures displayed on the keypad page can be set by means of the **P268b** ÷ **P268e** parameters; by pressing the **SAVE/ENTER** key from the keypad page, the Help page of the keypad is displayed for a few seconds where the description of the measures displayed on the keypad page is shown.

NOTE

If the **P264b** parameter Navigation mode with the MENU key is set as the Operator, navigation is blocked once the keypad page is displayed; this can be unblocked only by holding down the **ESC** key for a few seconds.

The possible keypad pages are:

- Only measures → four lines dedicated to measures;
- Speed → the fourth line displays the speed reference that may be modified with ▲ and ▼ keys;
- Torque → the fourth line displays the torque reference that may be modified with ▲ and ▼ keys;
- Torque Limit → the fourth line displays the torque limit reference that may be modified with ▲ and ▼ keys;
- PID → the fourth line displays the PID reference that may be modified with ▲ and ▼ keys.

If not in the Local mode, by using the **MENU** key in addition to the Only measures Keypad page, only those pages with references for which the keypad has been selected as source shall be displayed (see the CONTROL METHOD MENU and the PID CONFIGURATION MENU).

### LOCAL MODE

The **LOCAL** mode is an inverter command mode (indicated by the L-CMD L-REF led light) where only the command and references from the keypad are enabled, excluding all the other command or reference sources (see the CONTROL METHOD MENU, the DIGITAL INPUTS MENU and the INPUT REFERENCES MENU. Depending upon the setting of the **P266** parameter local keypad page type, the following keypad page will appear if the **LOC/REM** key is pressed:

- **P266 = Only measures** → Page with the four set measures, impossible to modify any of the references.
- **P266 = Ref. Activated** → The last line of the keypad page is the inverter reference, if a control is active in a speed mode there will be a speed reference, if a control is active in a torque mode, a torque mode will be active and if the inverter reference is the PID output (**C294** PID Action = 1:[Reference]) there will be a PID Ref. By using the ▲ and ▼ keys it is possible to modify the reference displayed on the fourth line of the keypad page.
- **P266 = Ref. Activated + Speed** → To be used only with a speed mode control, the inverter reference is given by the PID output (**C294** PID Action = 1:[Reference]) when pressing the **LOC/REM** key the startup time and entering the Local mode, the fourth line displays the PID Ref and it is possible to modify the PID reference, when pressed a second time the PID is excluded and it is possible to modify the speed reference. By using the ▲ and ▼ keys it is possible to modify the reference displayed on the fourth line of the keypad page.

## 10.4. List of Parameters from P264 to P269

Table 7: List of Parameters P264 ÷ P269

| Parameter | FUNCTION | Access Level | DEFAULT VALUE | MODBUS Address |
|---|---|---|---|---|
| P264 | Navigation mode | ADVANCED | 0 :[MENU] | 864 |
| P264a | Circular navigation of the menus mode | ADVANCED | 1: [YES] | 865 |
| P264b | Navigation mode with the **MENU** key | ADVANCED | 0:[STANDARD] | 512 |
| P265 | Startup page | ADVANCED | 0:[Status] | 866 |
| P266 | Keypad page type in local mode | ADVANCED | 1:[Ref. Activated] | 511 |
| P267 | Prefigured PID units of measure | ENGINEERING | 0:[Disabled] | 867 |
| P267a | Customised PID units of measure | ENGINEERING | [%] | 1867 |
| P268 | measure no.1 Root page | ADVANCED | M004 Motor Spd | – |
| P268a | measure no.2 Root page | ADVANCED | M000 Speed Ref. | – |
| P268b | measure no.1 Keypad page | ADVANCED | M006 Mot.Freq. | – |
| P268c | measure no.2 Keypad page | ADVANCED | M026 Motor Current | – |
| P268d | measure no. 3 Keypad page | ADVANCED | M004 Motor Spd | – |
| P268e | measure no.4 Keypad page | ADVANCED | M000 Speed Ref. | – |
| P269 | Keys disabled: **LOC/REM FWD/REV** | ENGINEERING | [NO NO] | 869 |

P264 Keypad navigation

| P264 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: By Menu<br>1: Only modified<br>2: Linear |
| | Default | 0 | 0: By Menu |
| | Level | ADVANCED | |
| | Address | 864 | |
| | Function | The inverter keypad is factory-set with navigation by menu. Navigation by menu is also preset at each power–on.<br>Set **P264**=1 :[Only Modified] to navigate only those parameters that have been modified with respect to the factory-set programming.<br>Navigation is no longer by menu but linear: the modified parameters are displayed in sequence, and with the ▲ and ▼ keys go from one parameter to another. If only a few parameters have been modified, navigation shall be slower because the inverter must find all the modified parameters amongst all the other parameters.<br>If the **P264** setting is 2:[Linear] the parameters can be displayed in sequence by using the ▲ and ▼ **keys** and are no longer divided into the menus. | |

**NOTE** This parameter cannot be saved: navigation by menu is restored every time the inverter is turned on.

P264a Circular Navigation

| P264a | Range | 0 ÷ 1 | 0: [NO]<br>1: [YES] |
|---|---|---|---|
| | Default | 1 | 1: [YES] |
| | Level | ADVANCED | |
| | Address | 865 | |
| | Function | With the factory setting **P264a**=1: [YES] navigation within each keypad menu is of a wrap type: navigation starting from the startup page of the menu, press the up key ▲ to go to the next page. At the last page press the up key ▲ again to return to the startup page of the menu.<br>To go to the last page of the menu from the startup page, press the down key ▼.<br>If **P264a**=0:[NO], it is no longer possible to continue by pressing the up key ▲, at the last page of the menu, but it is only possible to go back to the previous pages by pressing the down key ▼ back to the startup page. | |

P264b Navigation with the menu key

| P264b | Range | 0 ÷ 1 | 0: [STANDARD]<br>1: [OPERATOR] |
|---|---|---|---|
| | Default | 0 | 0: [STANDARD] |
| | Level | ADVANCED | |
| | Address | 512 | |
| | Function | When the MENU key is pressed from any parameter access is gained to the menu page in which that parameter is contained, when pressed again the Root page is displayed and from here, once the MENU key is pressed again the keypad page comes up.<br>When pressing the MENU key with the factory-setting **P264b**=0:[STANDARD]) the root page comes up and then the parameter from which the operation began.<br>If the keypad page is displayed with the **P264b**=1:[OPERATOR] setting, navigation is blocked and it is possible to continue only by holding the **ESC** key down for a few seconds; this is useful for preventing inexpert operators from using the keypad parameters. By setting **P265**= 1:[measures] as the startup page of the keypad and **P264b**=1:[OPERATOR], the navigation of the inverter will always be blocked for inexpert users. | |

P265 Startup Page

| P265 | Range | 0 ÷ 2 | 0: [Status]<br>1: [measures]<br>2: [Keypad] |
|---|---|---|---|
| | Default | 0 | 0: [Status] |
| | Level | ADVANCED | |
| | Address | 866 | |
| | Function | The **P265** setting determines the page to be displayed when the inverter is turned on.<br>The factory-set startup page is the Root page.<br>By setting **P265** = 1: [measures] the startup page will be the keypad page with the four measures, whilst by setting<br>**P265** = 2: [Keypad] the startup page is the keypad with the reference shown on the fourth line. | |

P266 Type of Keypad page in the local mode

| P266 | Range | 0 ÷ 2 | 0: [Only measures]<br>1: [Ref.Activated]<br>2: [Ref.Activated+Speed] |
|---|---|---|---|
| | Default | 1 | 1: [Ref.Activated] |
| | Level | ADVANCED | |
| | Address | 511 | |
| | Function | The **P266** setting determines the type of keypad page to be displayed in the Local mode.<br>By setting **P266 = 0: [Only measures]** and entering the local mode it is impossible to modify the reference.<br>With **P266 = 1: [Ref.Activated]** in local mode the keypad page displayed is the one relative to the activated reference; for example a torque control is obtained in the local mode where the torque Keypad page displays the fourth line that can modify the torque reference with the ▲ and ▼ keys.<br>With a speed control mode and a PID output (**C294** PID Action = 1:[Reference]) inverter reference it is advisable to exclude the PID during local mode operation and provide the speed reference directly from the keypad, this is possible by simply setting **P266 = 2: [Ref.Activated+Speed]**.<br>Therefore when entering the local mode (pressing **LOC/REM**) the Keypad page is displayed with the PID reference that may be modified with the▲ and ▼ keys. Press the **LOC/REM** key once more (with the inverter disabled) and the Keypad page will come up and the PID reference may be modified with the ▲ and ▼ keys. | |

P267 Preconfigured PID Units of measure

| P267 | Range | 0 ÷ 34 | Table 8 |
|---|---|---|---|
| | Default | 0 | 0: [Disabled] |
| | Level | ENGINEERING | |
| | Address | 867 | |
| | Function | The PID reference and feedback are expressed in % in the measures **M020**, M021.<br>With the **P257** parameter it is possible to set a gain level for "scaling" the reference and to feedback to obtain the measures:<br>**M023** = **P257** * **M020**;<br>**M024** = **P257** * **M021**;<br>these are to be suitably scaled and it is possible to select the unit of measure with the **P267** parameter (see code **P267**) or to key it in with the **P267a** parameter (displayed only if **P267** = 0:[Disabled]).<br><br>For example with 100% of the PID reference **M020** = 100% setting<br>**P257** = 0.04 and **P267** = 1:[bar] in correspondence with the abovementioned values, the scaled measure of the PID reference shall be → **M023** = 4.00 bar | |

Table 8: Preconfigured PID units of measure.

| Unit of measure | P267 | Code Displayed | Unit of measure | P267 | Code Displayed |
|---|---|---|---|---|---|
| Customised | 0: Disabled | ----(see **P267a**) | m | 18: m | m |
| bar | 1: bar | bar | ft | 19: ft | ft |
| mbar | 2: mbar | mbar | m/s | 20: m/s | m/s |
| atm | 3:atm | atm | ft/s | 21: ft/s | ft/s |
| Pa | 4: Pa | Pa | rpm | 22: rpm | rpm |
| kPa | 5: kPa | kPa | gal/s | 23: GPS | GPS |
| PSI | 6: PSI | PSI | gal/min | 24: GPM | GPM |
| $m^3/s$ | 7: m3/s | m3/s | gal/h | 25: GPH | GPH |
| $m^3/min$ | 8: m3/m | m3/m | $ft^3/s$ | 26: CFS | CFS |
| $m^3/h$ | 9: m3/h | m3/h | $ft^3/min$ | 27: CFM | CFM |
| l/s | 10: l/s | l/s | $ft^3/h$ | 28: CFH | CFH |
| l/min | 11: l/m | l/m | A | 29: A | A |
| l/h | 12: l/h | l/h | V | 30: V | V |
| ° | 13: ° | ° | W | 31: W | W |
| °C | 14: °C | °C | kW | 32: kW | kW |
| °F | 15: °F | °F | HP | 33: HP | HP |
| Nm | 16: Nm | Nm | CV | 34: CV | CV |
| kgm | 17: kgm | kgm | | | |

P267a Units of measure of the customised PID

| P267a | | | |
|---|---|---|---|
| | Range | 0x20 ÷ 0x8A (each byte) | ASCII 0x20 = blank<br>ASCII 0x8A = □ |
| | Default | 0x015D255B | ASCII 0x5D = [<br>ASCII 0x25 = %<br>ASCII 0x5B = ]<br>⇒ [%] |
| | Level | ENGINEERING | |
| | Address | 1861 | The 3 characters are coded with 8-bit ASCII bytes (byte 0, 1, 2).<br>Byte 3 is always 0x01. |
| | Function | The **P267a** parameter is displayed only if **P267** = 0:[Disabled] and in this condition it is the unit of measure that is actually displayed in **M023**, **M024**. With this parameter it is possible to define a 3-character string that is used for displaying the units of measure for the PID measures: **M023**, **M024**.<br>The change is made on the individual character, that are modified using the **SAVE/ENTER** key; the cursor will flash in front of the character on the left, by pressing the keys ▲ and ▼ it will be possible to scroll though all the characters that can be displayed. Once a character has been selected, the **ESC** key moves on to the next character. Once the third character has been selected, press the **SAVE/ENTER** key to save the parameter. | |

**NOTE** See also the description of the **P257** parameter in the PID PARAMETERS MENU.

P268 (P268a) measure n.1 (n.2) Root Page

| P268 / P268a | | |
|---|---|---|
| | Range | **M000** ÷ **M064** |
| | Default | **P268** → **M004** Motor Speed<br>**P268a** → **M000** Speed Ref. |
| | Level | ADVANCED |
| | Address | Not accessible via serial link. |
| | Function | The two parameters make it possible to select the two measures displayed on the root page from the inverter measures. |

P268b (P268c, P268d, P268e) measure n.1 (n.2, n.3, n.4) keypad page

| P268b, P268c, P268d, P268e | | |
|---|---|---|
| | Range | **M000** ÷ **M064** |
| | Default | **P268b** → **M006** Mot.Freq.<br>**P268c** → **M026** Motor Current<br>**P268d** → **M004** Motor Spd<br>**P268e** → **M000** Speed Ref. |
| | Level | ADVANCED |
| | Address | Not accessible via serial link. |
| | Function | The four parameters make it possible to select the four measures to be displayed on the keypad page.<br>NOTE: yhe fourth measure it is visible only in the keypad measure page; on the other keypad page it is replaced by the reference |

NOTE The fourth measure is displayed only on the Keypad page; on the other keypad pages it is replaced by the reference.

P269 Disabling of Keys: LOC/REM FWD/REV

| P269 | | | |
|---|---|---|---|
| | Range | 0 ÷ 3 | 0:[No No] - 3:[YES YES] |
| | Default | 0 | 0:[No No] |
| | Level | ENGINEERING | |
| | Address | 869 | |
| | Function | This parameter is useful for blocking either the **LOC/REM** key or the **FWD/REV** key or both.<br>The parameter is managed by bit: the O bit is relative to **LOC/REM**, whilst the 1 bit is relative to the **FWD/REV** key, if the value 0 is assigned to the relative bit it means NO, whilst 1 means Yes.<br>**P269** = 0 → both keys enabled.<br>**P269** = 1 → the **LOC/REM** key is disabled.<br>**P269** = 2 → the **FWD/REV** key is disabled.<br>**P269** = 3 → both keys disabled. | |

# 11. RAMPS MENU

## 11.1. Overview

An acceleration/deceleration ramp is a function allowing a linear variation of the motor speed.
The ramp time is the time the motor takes to reach its max. speed when it starts from zero speed (or the time the motor takes to reach 0 speed when decelerating).
Four pairs of programmable values are available. Each pair defines the motor acceleration time and deceleration time. The unit of measure of the basic time period is assigned to each pair of values.
In the Ramps menu, it is possible to set the acceleration and deceleration times for the four speed ramps available for ordinary operation, for the torque ramp and the speed/torque ramp in JOG mode.
Using two special parameters, it is also possible to set the start rounding off and the end rounding off for the acceleration ramps; using other two parameters, it is possible to set the start rounding off and the end rounding off for the deceleration ramps. A fifth parameter allows for the selection of the ramps for the preset rounding off.

### 11.1.1. DESCRIPTION OF THE SPEED RAMPS

For the four speed ramps that can be selected through a combination of the digital inputs set in **C167** and **C168**, you can set the following: acceleration time, deceleration time and their unit of measure, in order to increase the programmable time range.

**P009** Ramp Up Time 1
**P010** Ramp Down Time 1
**P012** Ramp Up Time 2
**P013** Ramp Down Time 2
**P014** Unit of Measure for Ramp Times 1 and 2

**P015** Ramp Up Time 3
**P016** Ramp Down Time 3
**P018** Ramp Up Time 4
**P019** Ramp Down Time 4
**P020** Unit of Measure for Ramp Times 3 and 4

The set ramp time corresponds to the time the speed reference takes to reach the max. speed (from 0 rpm) as an absolute value between min. speed and max. speed of the selected motor (**C028** and **C029** for the first motor, and so on). The time unit of measure may have the following values:

0 → 0.01 s
1 → 0.1 s
2 → 1 s
3 → 10 s

The programmable range may be 0s – 327000s.
Example of a speed ramp:

**Table 9: Example of a Speed Ramp**

| P014 | | Range P009 – P010 | |
|---|---|---|---|
| Value | Codification | Min. | Max. |
| 0 | 0.01 s | 0 | 327.00 s |
| 1 | 0.1 s | 0 | 3270.0 s |
| 2 | 1s | 0 | 32700 s |
| 3 | 10 s | 0 | 327000 s |

The factory setting of the unit of measure is 0.1 s; the ramp time is 10 sec.

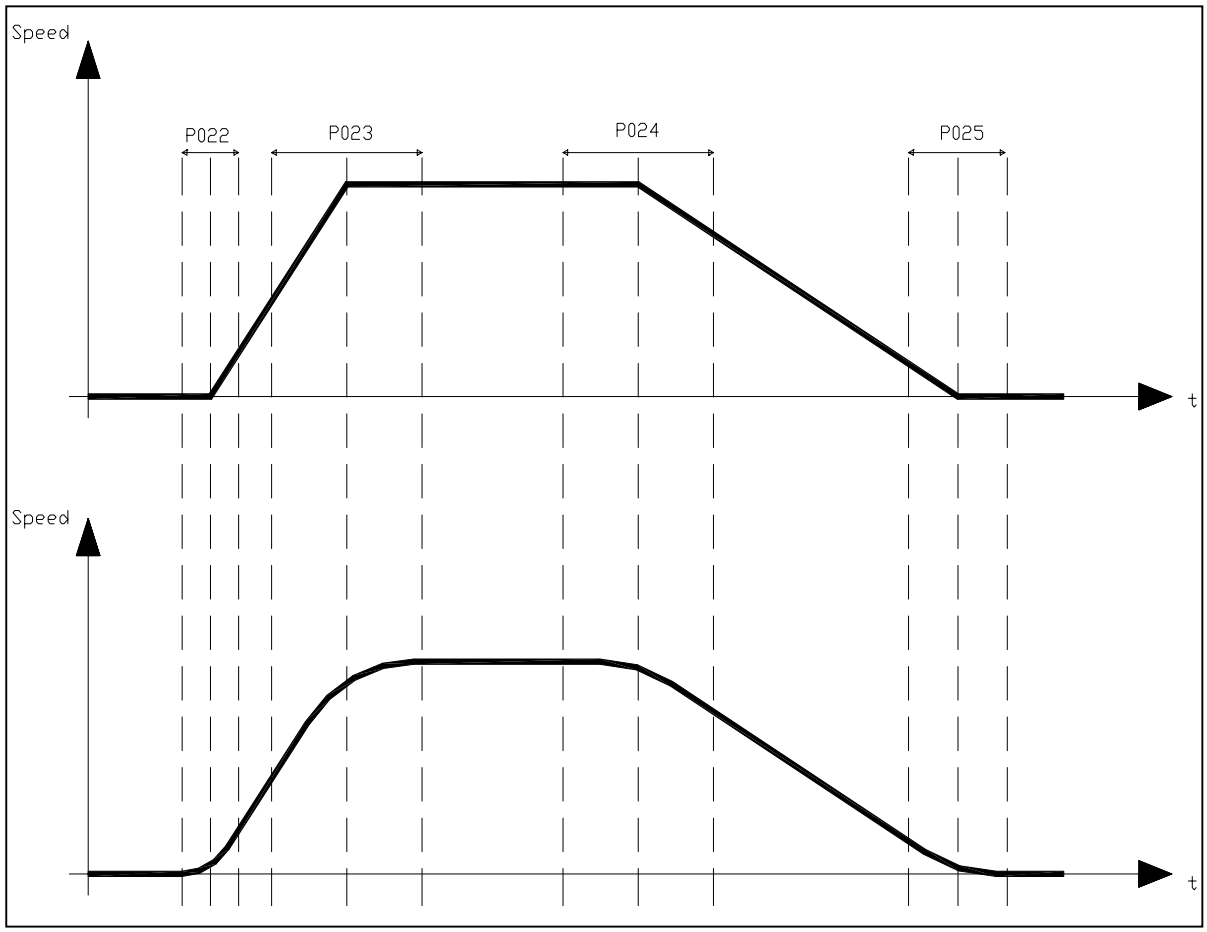



**Figure 4: S ramps Application (Example)**

It is also possible to select the rounding off and the rounding off percentage for the 4 stages of starting ramp up and the starting ramp down, and for the end ramp up and the end ramp down (S ramps). S ramps rounding off makes it possible to reach the reference end value with a zero tangent, both while accelerating and while decelerating, thus suppressing torque peaks that could damage mechanical couplings.
The rounding off is expressed as a percentage of the ramp time it relates to; if used, it allows to increase the preset ramp time by half the sum value of the two rounding off values. Its effect is shown in the figures below.

Example: **P009** = 10sec ; **P021** = 1111 binary (rounding off selected for all four ramps); **P022** = 50%; **P023** = 50%
The resulting ramp up time is:
**P009** + (( **P009*** (**P022**+**P023**)/2 )/100 ) = 10 + (( 10* (50+50)/2 )/100 ) = 15 sec

The effect of this rounding off can be seen in the figures below:

The figure shows two trends for the ramp reference. The first trend has different ramp up and ramp down times and is not rounded off; the second trend has the same ramp times, but different rounding off values are applied for the start/end ramp up/down time.

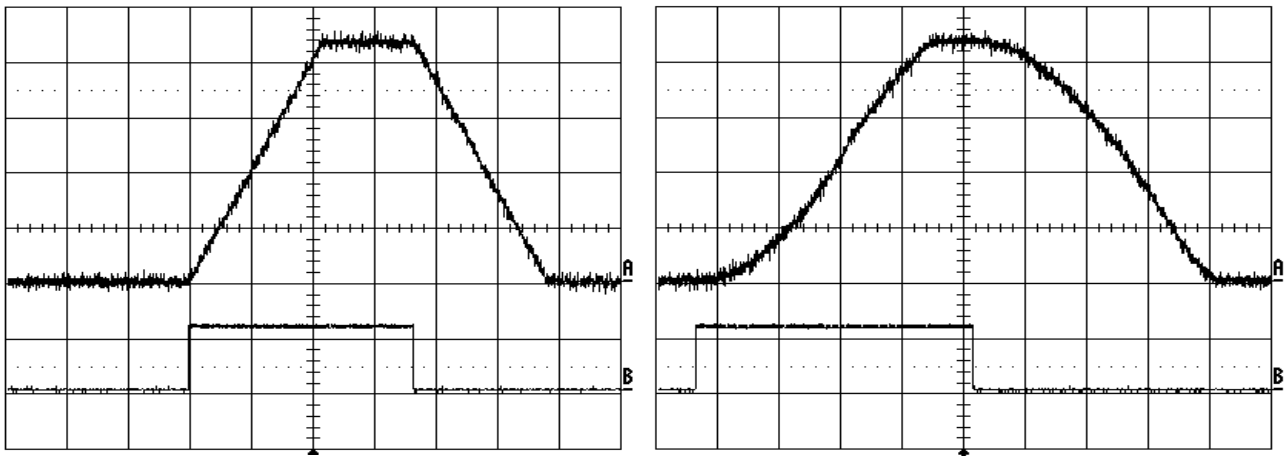



Figure 5: Speed Profile without Rounding Off and with Rounding Off 2 (Example)

In the above figures, the run command is represented by the high level of the second signal. Note that the time the reference takes to reach constant rpm depends not only on the ramp times, but also on the rounding off values you have defined.

### Acceleration RESET function.

This parameter has effect only if S ramps are used. Parameter **P031** enables to reset acceleration when reference trends change.
Whenever a speed reference trend changes, the motor acceleration is instantly set to zero and the ramp output reference will be computed considering the preset rounding off (see Figure 6). The figure shows the passage from the acceleration stage to the deceleration stage; the rounding off value assigned to the speed reference in correspondence to the change in gradient is the value set for the deceleration starting stage.
If parameter **P031** is set to [No], acceleration is brought to zero before the speed reference starts decreasing, then deceleration begins with the preset pattern.

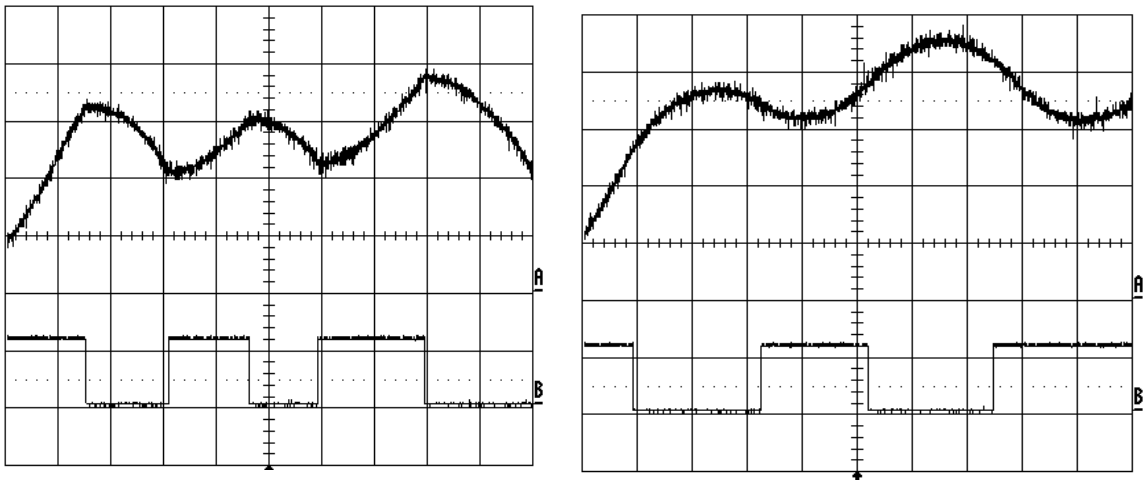



Figure 6: Speed Profile with Acceleration Reset Yes to No (Example)

### 11.1.2. DESCRIPTION OF THE TORQUE RAMPS

If the control algorithm is VTC or FOC and if it is controlled by setting "Torque" (**C011** for motor 1, **C054** for motor 2, and **C097** for motor 3 respectively), the reference is "ramped" based on the values set in parameter **P026** (torque increase ramp time), **P027** (torque decrease ramp time), and **P028** (unit of measure for the ramp times). The ramp up time setting is the time the output torque reference takes to go from 0 to the max. value (as an absolute value) between Torque min. and Torque max. of the selected motor (**C047**, **C048** for motor 1 and so on).

## 11.2. List of Parameters from P009 to P033

Table 10: List of Parameters P009 ÷ P033

| Parameter | FUNCTION | Access Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| P009 | Speed ramp 1: acceleration time | BASIC | 10 s | 609 |
| P010 | Speed ramp 1: deceleration time | BASIC | 10 s | 610 |
| P012 | Speed ramp 2: acceleration time | ADVANCED | 10 s | 612 |
| P013 | Speed ramp 2: deceleration time | ADVANCED | 10 s | 613 |
| P014 | Speed ramps 1and 2: time unit of measure | ADVANCED | 0.1 s | 614 |
| P015 | Speed ramp 3: acceleration time | ADVANCED | 10 s | 615 |
| P016 | Speed ramp 3: deceleration time | ADVANCED | 10 s | 616 |
| P018 | Speed ramp 4: acceleration time | ADVANCED | 10 s | 618 |
| P019 | Speed ramp 4: deceleration time | ADVANCED | 10 s | 619 |
| P020 | Speed ramps 3 and 4: time unit of measure | ADVANCED | 0.1 s | 620 |
| P021 | Selection for S ramp rounding off | ADVANCED | 111b (all S ramps) | 621 |
| P022 | Acceleration S ramp: start rounding off time | ADVANCED | 50% | 622 |
| P023 | Acceleration S ramp: end rounding off time | ADVANCED | 50% | 623 |
| P024 | Deceleration S ramp: start rounding off time | ADVANCED | 50% | 624 |
| P025 | Deceleration S ramp: end rounding off time | ADVANCED | 50% | 625 |
| P026 | Torque ramp time: up | ADVANCED | 5 s | 626 |
| P027 | Torque ramp time: down | ADVANCED | 5 s | 627 |
| P028 | Unit of measure for torque ramp time | ADVANCED | 10.1 s | 628 |
| P029 | Jog ramp acceleration time | ADVANCED | 1 s | 629 |
| P030 | Jog ramp deceleration time | ADVANCED | 1 s | 629 |
| P031 | Gradient variation acceleration reset | ADVANCED | 1 : (YES) | 631 |
| P032 | Fire Mode Ramp: acceleration time | ENGINEERING | 10 s | 632 |
| P033 | Fire Mode Ramp: deceleration time | ENGINEERING | 10 s | 633 |

P009 Speed Ramp 1: Acceleration Time

| | | | |
|---|---|---|---|
| P009 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P014**=0 → 0.01 s<br>0 ÷3270.0 s if **P014**=0 → 0.1 s<br>0 ÷32700 s if **P014**=0 → 1 s<br>0 ÷327000 s if **P014**=0 → 10 s |
| | Default | 100 | 10 sec |
| | Level | BASIC | |
| | Address | 609 | |
| | Function | Determines the time the reference takes to go from 0 rpm to the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the selected motor).<br>If S ramps are used, the actual time the reference takes to reach constant rpm exceeds the time set in **P009** for a percentage equal to (**P022**+**P023**)/2. | |

P010 Speed Ramp 1: Deceleration Time

| | | | |
|---|---|---|---|
| P010 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P014**=0 → 0.01 s<br>0 ÷3270.0 s if **P014**=0 → 0.1 s<br>0 ÷32700 s if **P014**=0 → 1 s<br>0 ÷327000 s if **P014**=0 → 10 s |
| | Default | 100 | 10 sec |
| | Level | BASIC | |
| | Address | 610 | |
| | Function | Determines the time the reference takes to go from the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the selected motor) to zero rpm.<br>If S ramps are used, the actual time the reference takes to reach 0 speed exceeds the time set in **P010** for a percentage equal to (**P024**+**P025**)/2. | |

P012 Speed Ramp 2: Acceleration Time

| | | | |
|---|---|---|---|
| P012 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P014**=0 → 0.01 s<br>0 ÷3270.0 s if **P014**=0 → 0.1 s<br>0 ÷32700 s if **P014**=0 → 1 s<br>0 ÷327000 s if **P014**=0 → 10 s |
| | Default | 100 | 10 sec |
| | Level | ADVANCED | |
| | Address | 612 | |
| | Function | Same as ramp 1 (see **P009**). | |

NOTE

In order to be able to apply ramp 2 to the reference, the multiramp digital inputs must be programmed and ramp 2 selected (see DIGITAL INPUTS MENU).

P013 Speed Ramp 2: Deceleration Time

| | | | |
|---|---|---|---|
| P013 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P014**=0 → 0.01 s<br>0 ÷3270.0 s if **P014**=0 → 0.1 s<br>0 ÷32700 s if **P014**=0 → 1 s<br>0 ÷327000 s if **P014**=0 → 10 s |
| | Default | 100 | 10 sec |
| | Level | ADVANCED | |
| | Address | 613 | |
| | Function | Same as ramp 1 (see **P010**). | |

NOTE

In order to be able to apply ramp 2 to the reference, the multiramp digital inputs must be programmed and ramp 2 selected (see DIGITAL INPUTS MENU).

## P014 Speed Ramps 1 and 2: Time Unit of Measure

| P014 | Range | 0 ÷ 3 | 0 → 0.01 s<br>1→ 0.1 s<br>2→ 1 s<br>3→ 10 s |
|---|---|---|---|
| | Default | 1 | 1→ 0.1 s |
| | Level | ADVANCED | |
| | Address | 614 | |
| | Function | Defines the unit of measure for the times for speed ramp 1 **P009** and **P010** and speed ramp 2 **P012** and **P013**, so that range for the programmable ramps may be extended from 0 s to 327000s.<br>e.g.<br>**P014**=1 then **P009**=100 means **P009** = 100 x 0.1 s = 10 s<br>**P014**=0 then **P009**=100 means **P009** = 100 x 0.01 s = 1 s<br>**P014**=3 then **P009**=100 means **P009** = 100 x 10 s = 1000 s | |

## P015 Speed Ramp 3: Acceleration Time

| P015 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P020**=0 → 0.01 s<br>0 ÷3270.0 s if **P020**=0 → 0.1 s<br>0 ÷32700 s if **P020**=0 → 1 s<br>0 ÷327000 s if **P020**=0 → 10 s |
|---|---|---|---|
| | Default | 100 | 10 sec |
| | Level | ADVANCED | |
| | Address | 615 | |
| | Function | Same as ramp 1 (see **P009**). | |

NOTE

In order to be able to apply ramp 3 to the reference, the multiramp digital inputs must be programmed and ramp 3 selected (see DIGITAL INPUTS MENU).

## P016 Speed Ramp 3: Deceleration Time

| P016 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P020**=0 → 0.01 s<br>0 ÷3270.0 s if **P020**=0 → 0.1 s<br>0 ÷32700 s if **P020**=0 → 1 s<br>0 ÷327000 s if **P020**=0 → 10 s |
|---|---|---|---|
| | Default | 100 | 10 sec |
| | Level | ADVANCED | |
| | Address | 616 | |
| | Function | Same as ramp 1 (see **P010**). | |

NOTE

In order to be able to apply ramp 3 to the reference, the multiramp digital inputs must be programmed and ramp 3 selected (see DIGITAL INPUTS MENU).

P018 Speed Ramp 4: Acceleration Time

| | | | |
|---|---|---|---|
| P018 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P020**=0 → 0.01 s<br>0 ÷3270.0 s if **P020**=0 → 0.1 s<br>0 ÷32700 s if **P020**=0 → 1 s<br>0 ÷327000 s if **P020**=0 → 10 s |
| | Default | 100 | 10 sec |
| | Level | ADVANCED | |
| | Address | 618 | |
| | Function | Same as ramp 1 (see **P009**). | |

NOTE

In order to be able to apply ramp 4 to the reference, the multiramp digital inputs must be programmed and ramp 4 selected (see DIGITAL INPUTS MENU).

P019 Speed Ramp 4: Deceleration Time

| | | | |
|---|---|---|---|
| P019 | Range | 0 ÷ 32700 | 0 ÷327.00 s if **P020**=0 → 0.01 s<br>0 ÷3270.0 s if **P020**=0 → 0.1 s<br>0 ÷32700 s if **P020**=0 → 1 s<br>0 ÷327000 s if **P020**=0 → 10 s |
| | Default | 100 | 10 sec |
| | Level | ADVANCED | |
| | Address | 619 | |
| | Function | Same as ramp 1 (see **P010**). | |

NOTE

In order to be able to apply ramp 4 to the reference, the multiramp digital inputs must be programmed and ramp 4 selected (see DIGITAL INPUTS MENU).

P020 Speed Ramps 3 and 4: Time Unit of Measure

| | | | |
|---|---|---|---|
| P020 | Range | 0 ÷ 3 | 0 → 0.01 s<br>1→ 0.1 s<br>2→ 1 s<br>3→ 10 s |
| | Default | 1 | 1→ 0.1 s |
| | Level | ADVANCED | |
| | Address | 620 | |
| | Function | Defines the unit of measure for the times for speed ramp 3 **P015** and **P016** and speed ramp 4 **P020** and **P018**, so that range for the programmable ramps may be extended from 0 s to 327000s. | |

## P021 Selection for Ramp Rounding Off

| | | | |
|---|---|---|---|
| P021 | Range | 0000b ÷ 1111b binary<br>0x0000 ÷ 0x000F hexadecimal<br>0 ÷ 15 | 0000b (no ramp is rounded off);<br>1111b (all ramps are rounded off) |
| | Default | 1111b = 0x000F = 15 | 1111b (all ramps are rounded off) |
| | Level | ADVANCED | |
| | Address | 621 | |
| | Function | In this parameter, you can select the bit corresponding to the ramp to be rounded off.<br>Example:<br>**P021** = 0011b = 3 decimal → ramps 1 and 2 are rounded off<br>The ramp rounding off allows reaching the reference end value with a zero tangent, both while accelerating and while decelerating, thus suppressing torque peaks that could damage mechanical couplings. | |

## P022 Acceleration Ramp: Start Rounding Off Time

| | | | |
|---|---|---|---|
| P022 | Range | 0 ÷ 100 | 0 ÷ 100 % |
| | Default | 50 | 50% |
| | Level | ADVANCED | |
| | Address | 622 | |
| | Function | Sets the rounding off time period for the first stage of the acceleration ramp. This parameter is expressed as a percentage of the acceleration ramp time of the active ramp.<br>Example: the second ramp is active with an acceleration ramp time of 5sec, P022 = 50%. Therefore, reference acceleration is limited for the first 2.5 sec of the ramp time. | |

NOTE When using parameter **P022**, the preset acceleration ramp time is increased by: (**P022**%)/2

## P023 Acceleration Ramp: End Rounding Off Time

| | | | |
|---|---|---|---|
| P023 | Range | 0 ÷ 100 | 0 ÷ 100 % |
| | Default | 50 | 50% |
| | Level | ADVANCED | |
| | Address | 623 | |
| | Function | Sets the rounding off time period for the end stage of the acceleration ramp. This parameter is expressed as a percentage of the acceleration ramp time of the active ramp. | |

NOTE When using parameter **P023**, the preset acceleration ramp time is increased by: (**P023**%)/2

## P024 Deceleration Ramp: Start Rounding Off Time

| P024 | | | |
|---|---|---|---|
| | Range | 0 ÷ 100 | 0 ÷ 100 % |
| | Default | 50 | 50% |
| | Level | ADVANCED | |
| | Address | 624 | |
| | Function | See function for **P022**. The only difference is that this rounding off function is applied to the first stage of a deceleration ramp. | |

NOTE When using parameter **P024**, the preset deceleration ramp time is increased by: (**P024**%)/2

## P025 Deceleration Ramp: End Rounding Off Time

| P025 | | | |
|---|---|---|---|
| | Range | 0 ÷ 100 | 0 ÷ 100 % |
| | Default | 50 | 50% |
| | Level | ADVANCED | |
| | Address | 625 | |
| | Function | See function for **P023**. The only difference is that this rounding off function is applied to the last stage of a deceleration ramp. | |

NOTE When using parameter **P025**, the preset deceleration ramp time is increased by: (**P025**%)/2

## P026 Torque Ramp Time: Up

| P026 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32700 | Function of **P028** |
| | Default | 500 | 50 sec |
| | Level | ADVANCED | |
| | Address | 626 | |
| | Function | Defines the time taken by the torque reference of the selected motor to go to zero from max. value (as an absolute value between Torque min. and Torque max.); (**C047**–**C048** for motor 1 and so on). | |

## P027 Torque Ramp Time: Down

| P027 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32700 | Function of **P028** |
| | Default | 500 | 50 sec |
| | Level | ADVANCED | |
| | Address | 627 | |
| | Function | Defines the time taken by the torque reference of the selected motor to go from max. value to zero (as an absolute value between Torque min. and Torque max.); (**C047**–**C048** for motor 1 and so on). | |

## P028 Unit of Measure for Torque Ramp Time

| P028 | Range | 0 ÷ 3 | 0 → 0.01 s<br>1 → 0.1 s<br>2 → 1 s<br>3 → 10 s |
|---|---|---|---|
| | Default | 1 | 1 → 0.1 s |
| | Level | ADVANCED | |
| | Address | 628 | |
| | Function | Defines the unit of measure for the torque ramp times. See unit of measure for ramp 1 (par. **P014**). | |

## P029 Jog Ramp Acceleration Time

| P029 | Range | 0 ÷ 6500 | 0 ÷ 6500 sec |
|---|---|---|---|
| | Default | 1 | 1sec |
| | Level | ADVANCED | |
| | Address | 629 | |
| | Function | The preset time corresponds to the time the "ramped" speed/torque reference takes to go from zero to JOG speed/torque value (**P070**). | |

## P030 Jog Ramp Deceleration Time

| P030 | Range | 0 ÷ 6500 | 0 ÷ 6500 sec |
|---|---|---|---|
| | Default | 1 | 1sec |
| | Level | ADVANCED | |
| | Address | 630 | |
| | Function | The preset time corresponds to the time the "ramped" speed/torque reference takes to go from JOG speed/torque value (**P070**) to zero. | |

## P031 Gradient Variation Acceleration Reset

| P031 | Range | 0 ÷ 1 | 0: [No] ; 1: [Yes] |
|---|---|---|---|
| | Default | 1 | 1: [Yes] |
| | Level | ADVANCED | |
| | Address | 631 | |
| | Function | Defines whether to reset acceleration or not when switching from acceleration to deceleration and vice versa (reference gradient). For more details, see description of speed ramps at the beginning of this section. | |

## P032 Fire Mode Acceleration Ramp

| P032 | Range | 0 ÷ 32700 | 0 ÷ 3270.0 s |
|---|---|---|---|
| | Default | 100 | 10 sec |
| | Level | ENGINEERING | |
| | Address | 631 | |
| | Function | This ramp is used to accelerate the motor when in Fire Mode. | |

## P033 Fire Mode Deceleration Ramp

| P033 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32700 | 0 ÷ 3270.0 s |
| | Default | 100 | 10 sec |
| | Level | ENGINEERING | |
| | Address | 633 | |
| | Function | This ramp is used to decelerate the motor when in Fire Mode. | |

# 12. INPUT REFERENCES MENU

## 12.1. Processing Speed/Torque References

The "**main reference**" is the value, at constant rpm, for the controlled physical variable (speed or torque) (**M000**, **M007**) "required" for the inverter.
This reference is acquired by the inverter only if the **START** command is active and the inverter is **RUNNING**, otherwise it is ignored.
The **main reference** is the reference at constant rpm: when the inverter is **RUNNING**, it will increment the speed or torque **set–point** which will reach the main reference with a timed ramp (see RAMPS MENU).
The factory-setting for the inverter operating mode is **MASTER** with a **speed** reference. In the **SLAVE** mode, the reference is a **torque** reference; this operating mode may be configured only for **VTC** control (Vector Torque Control) and **FOC** control (Field Oriented Control).
The **control algorithm** and the **MASTER/SLAVE mode** can be set for each of the 3 programmable motors, depending on which motor is active at that moment (motor 1, motor 2 or motor 3).
To enable the **SLAVE** mode, set the following parameters to **1**:
**C011** (motor 1)
**C054** (motor 2)
**C097** (motor 3)
The SLAVE mode may also be selected through a digital input (see DIGITAL INPUTS MENU).
When the main reference is acquired by the inverter (**RUNNING** on), it becomes the reference for the time ramps generating the current speed/torque set–point for the connected motor.
The set up of the main reference is based on a number of parameters included in several menus:

**Table 11: Parameters Used for References Menu**

| Parameters | Menu | Contents |
|---|---|---|
| P050 ÷ P074 | Reference | Scaling parameters for references sent from analog inputs REF, AIN1, AIN2.<br>Scaling parameters for references sent from encoder and frequency input.<br>Parameters for modifications using UP and DOWN keys.<br>Parameter for JOG reference set up.<br>Parameter for inverter disabling in case of reference at min. value. |
| P080 ÷ P098 | Preset Speed | Parameters setting preset speed values to be selected through digital inputs. |
| P105 ÷ P108 | Prohibit Speed | Parameters setting prohibit speed values. |
| P115 ÷ P121 | Percent Variation | Parameters setting slowing down values percent to be selected through digital inputs. |
| C143 ÷ C146 | Control Method | Parameters setting the reference source. |
| C011, C028, C029 | Motor 1 | Parameter setting Master (speed) mode or Slave (torque) mode.<br>Parameters setting min. speed and max. speed.<br>***For motor n.1*** |
| C054, C071, C072 | Motor 2 | Parameter setting Master (speed) mode or Slave (torque) mode.<br>Parameters setting min. speed and max. speed.<br>***For motor n.2*** |
| C097, C114, C115 | Motor 3 | Parameter setting Master (speed) mode or Slave (torque) mode.<br>Parameters setting min. speed and max. speed.<br>***For motor n.3*** |
| C047, C048 | Current Limit n.1 | Parameters setting min. torque and max. torque.<br>***For motor n.1*** |
| C090, C091 | Current Limit n.2 | Parameters setting min. torque and max. torque.<br>***For motor n.2*** |
| C133, C134 | Current Limit n.3 | Parameters setting min. torque and max. torque.<br>***For motor n.3*** |

The following pages contain block diagrams illustrating speed reference processing (Figure 6) and torque reference processing (Figure 7). Menus and parameters used are also stated.

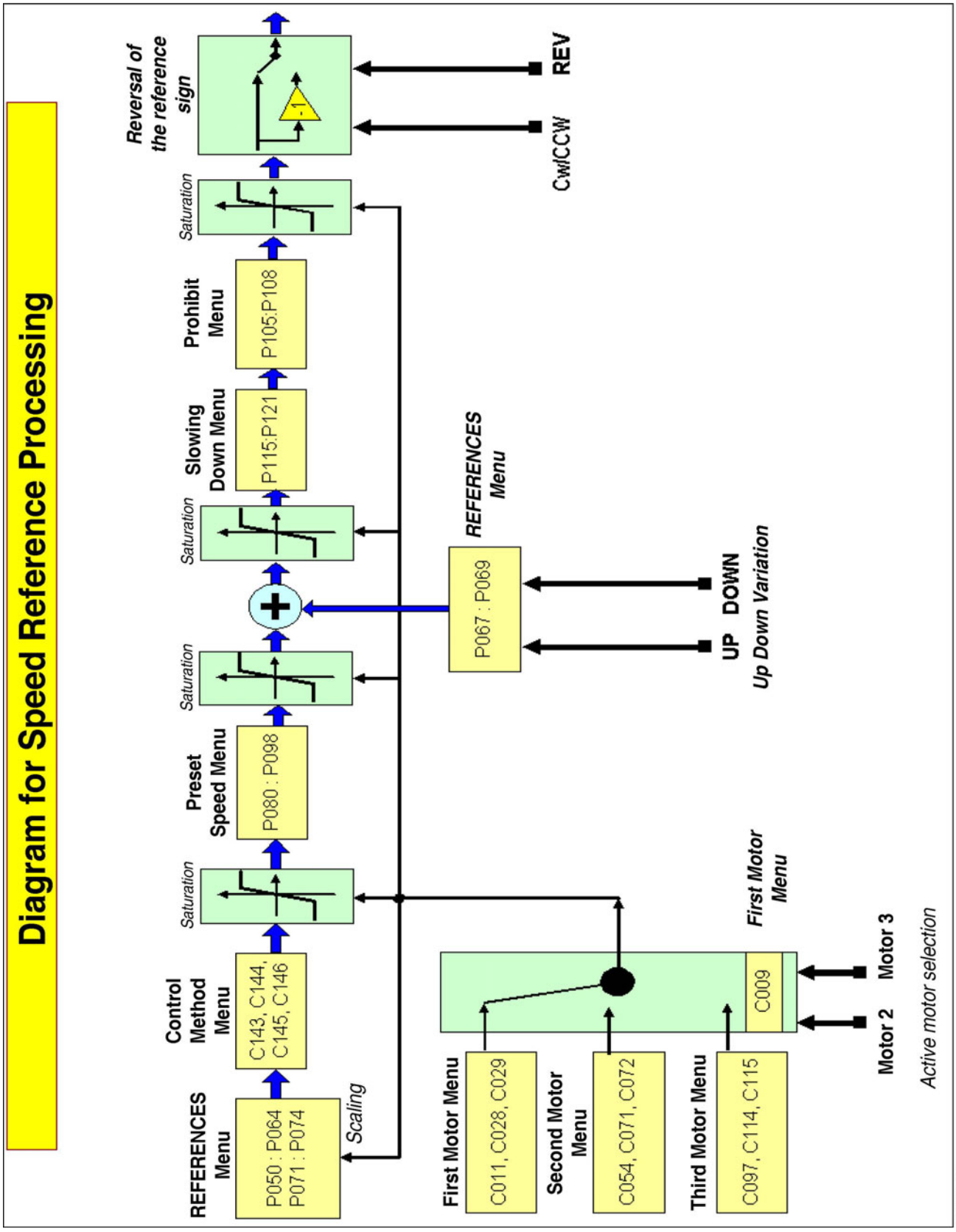



Figure 7: Speed Reference Processing

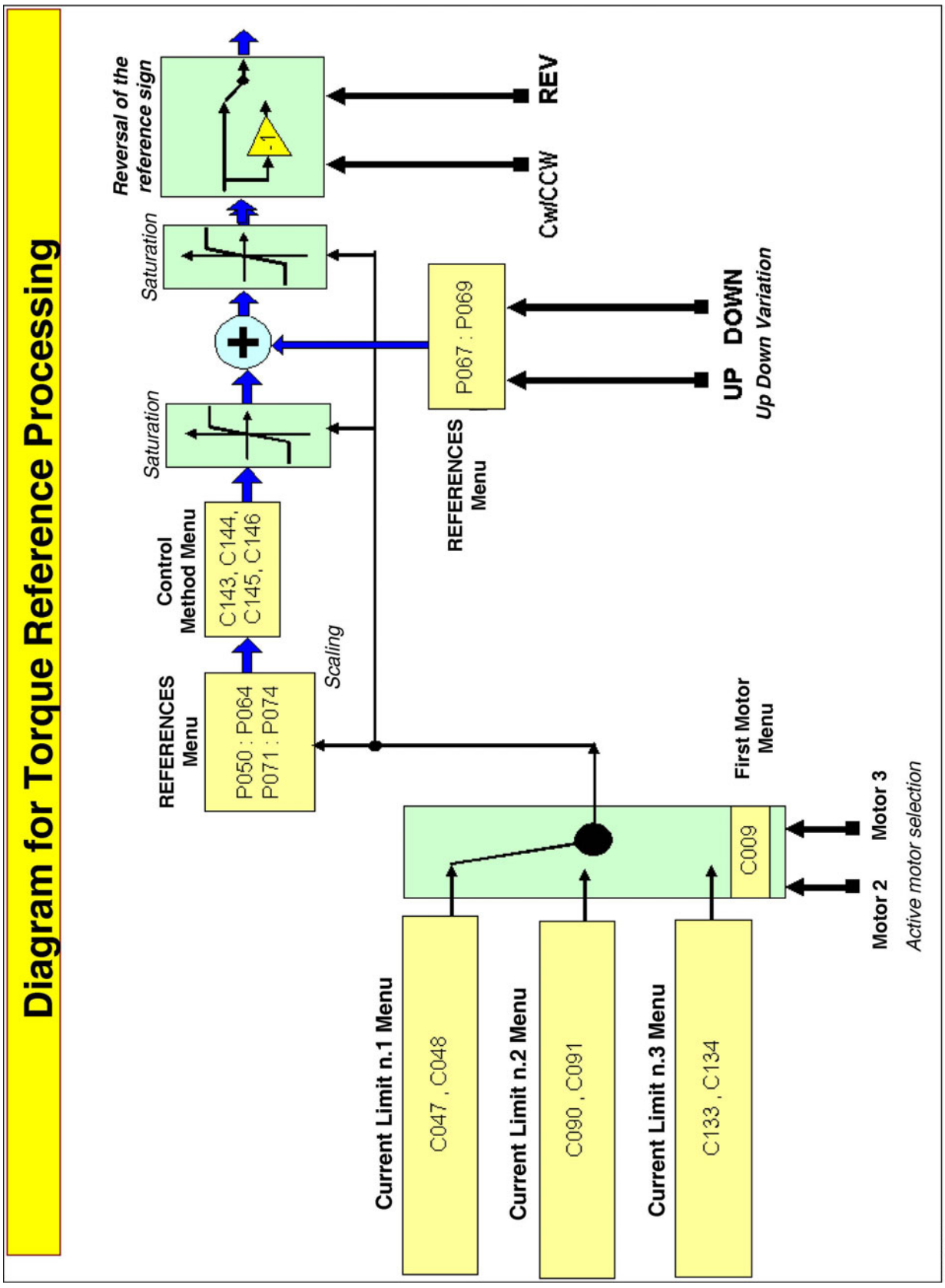



Figure 8: Torque Reference Processing

## 12.2. Scaling Analog Inputs REF, AIN1, AIN2 (Terminals 1-2; 5-6; 7-8)

**NOTE** Refer to the Installation Instructions for hardware details concerning analog inputs.

Three analog inputs are available: REF, AIN1, AIN2.
They can be voltage inputs or current inputs (switching is made possible through hardware Dip–Switch **SW1** and software parameters) and are bipolar analog inputs (–10V ÷ +10V or –20mA ÷ +20mA).
**REF** input is single–ended; inputs **AIN1** and **AIN2** are differential inputs.
Factory setting is as follows: the **main speed reference** is given by analog input **REF,** mode **0V ÷ +10V**; only motor 1 is active. Its max. speed and min. speed parameters are **C088**=**1500** rpm and **C029**=**0** rpm respectively.
For the 3 analog inputs, parameters **P050** ÷ **P064** allow to set the type of signal to be acquired, offset compensation (if any), scaling to obtain a speed reference or a torque reference, the signal filtering time constant.
Parameter **P053** sets the offset of the input analog signal (if **P053**=0 offset is zero), while parameter P054 defines the filtering time constant (factory setting: P054 = 5ms).
Type of input: for each analog input, Dip–Switch **SW1** allows to set the acquisition method of the input signal: voltage signal or current signal.
The voltage signal can be bipolar (**–10V ÷ +10V**) or unipolar (0V ÷ **+10V**).
The current signal can be bipolar: (**–20mA ÷ +20mA**), unipolar (**0mA ÷ +20mA**) or with a minimum offset (**4mA ÷ 20mA**).
The user will set each analog input mode in parameters **P050**, **P055**, **P060**.

**Table 12: Analog Input Hardware Mode**

| Type / Terminals | Name | Type | Dip–Switch | Parameter |
|---|---|---|---|---|
| Single-ended input / 1,2 | REF | Input ±10V | SW1–A off | P050 |
| | | Input 0–20mA | SW1–A on | |
| Differential input / 5,6 | AIN1 | Input ±10V | SW1–B off | P055 |
| | | Input 0–20mA | SW1–B on | |
| Differential input / 7,8 | AIN2 | Input ±10V | SW1–C off, SW1–D E off | P060 |
| | | Input 0–20mA | SW1–C on, SW1–D E off | |
| | | Input PTC | SW1–C off, SW1–D E on | See note |

**NOTE** If AIN2 input is configured as PTC, refer to MOTOR THERMAL PROTECTION MENU to select the proper parameters. Its measures are not significant any longer.

**NOTE** Configurations not explicitely showed are not allowed.

**CAUTION** For each analog input (REF, AIN1, AIN2), check that the "mode" parameter setting (**P050**, **P055**, **P060**) matches with the setting of the relevant Dip–Switches SW1.

Scaling is obtained by setting the parameters relating to the **linear function for the conversion** from the value read by the analog input to the corresponding speed/torque reference value.
The **conversion function** is a **straight line** passing through **2 points** in **Cartesian coordinates** having the values read by the analog input in the X-axis value, and the speed/torque reference values in the ordinate.

**Each point** is detected through its **two coordinates**.
The ordinates of the two points are the following:
the value of **Vel_Min** (or **Trq_Min** for the torque reference) for the **first point**; the value of **Vel_Max** (or **Trq_Max** for the torque reference) for the **second point**.

**Vel_Min** depends on the selected motor: see parameter **C028** (motor 1), **C071** (motor 2), or **C114** (motor 3).
**Trq_Min** depends on the selected motor: see parameter **C047** (motor 1), **C090** (motor 2) or **C133** (motor 3).
**Vel_Max** depends on the selected motor: see parameter **C029** (motor 1), **C072** (motor 2) or **C115** (motor 3).
**Trq_Max** depends on the selected motor: see parameter **C048** (motor 1), **C091** (motor 2), or **C134** (motor 3).

The X-axis values of the two points depend on the analog input:
Input **REF**:
Parameter **P051** is the X-axis value of the **first point;** parameter **P052** is the X-axis value of the **second point.**
Input **AIN1**:
Parameter **P056** is the X-axis value of the **first point;** parameter **P057** is the X-axis value of the **second point.**
Input **AIN2**:
Parameter **P061** is the X-axis value of the **first point;** parameter **P062** is the X-axis value of the **second point.**

The figure below illustrates how parameters set processing the signals for speed (or torque) analog reference.

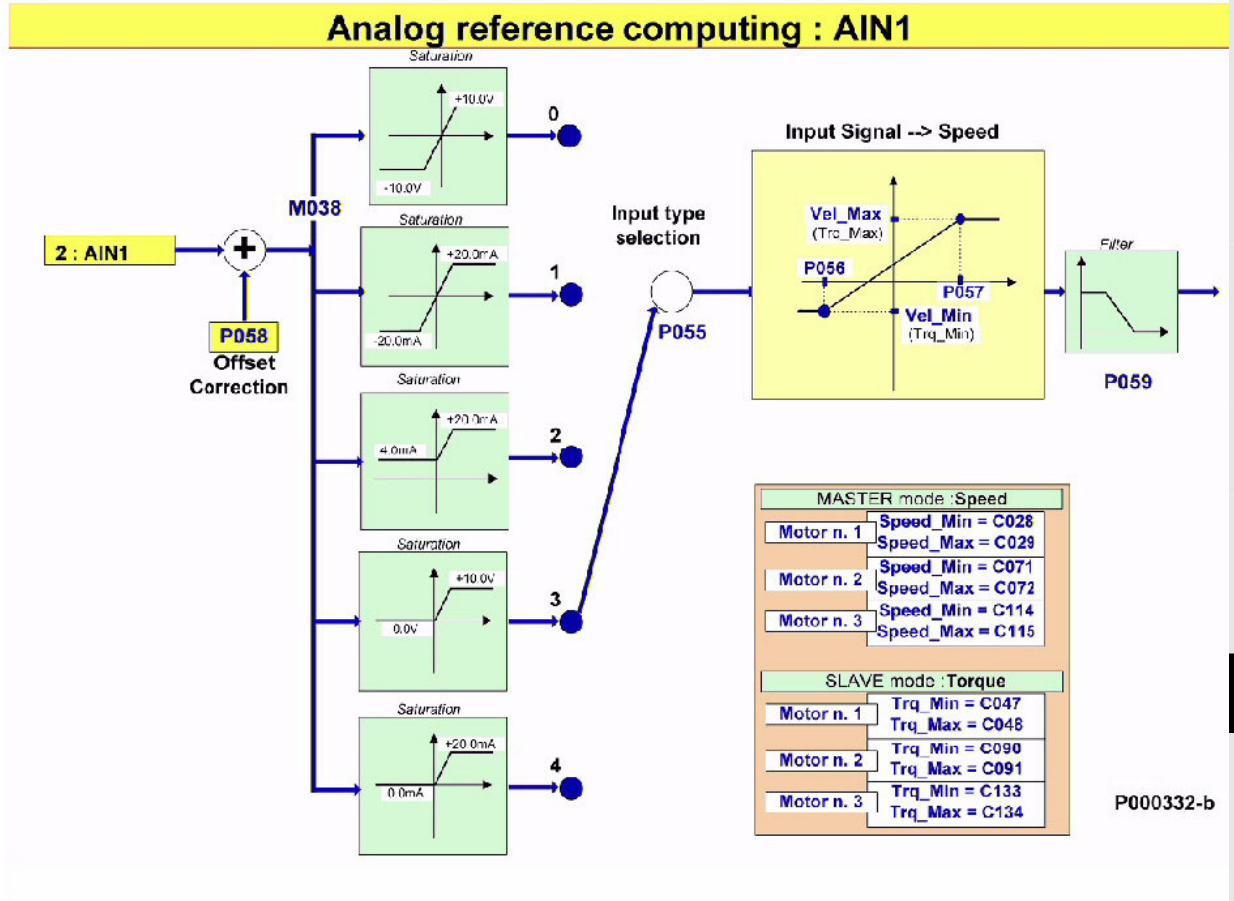



**Figure 9: Processing Speed Analog Reference from Terminal Board: AIN1**

The figures below illustrate programming examples for REF analog input, if motor 1 is selected and in MASTER mode: speed reference

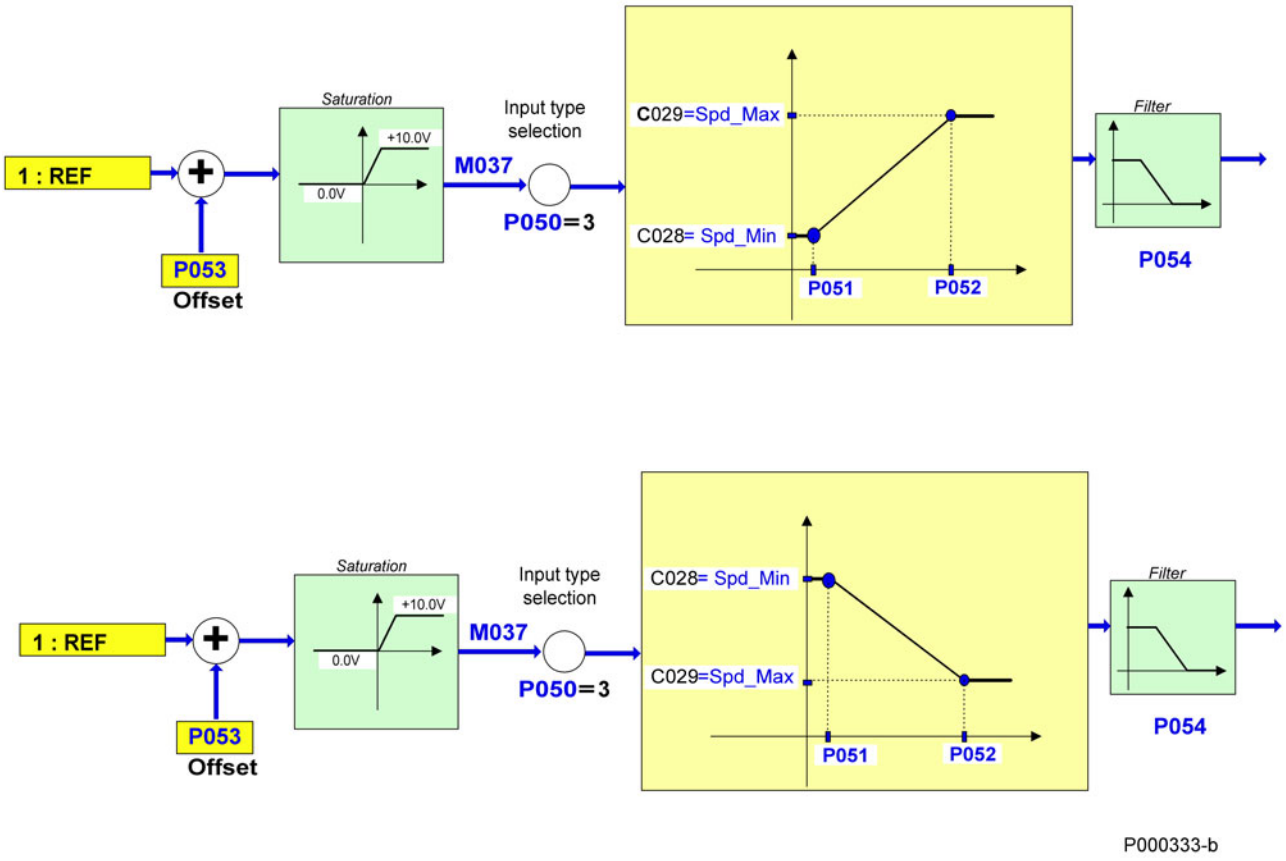



**Figure 10: Input REF Processing (Example 1)**

Settings of the first example shown in the figure
**P050 = 3**
**P051** = 1V; **P052** = 10V;
Vel_Min = **C028** = 100 rpm; Vel_Max = **C029** = 1100 rpm

**Figure 11: Input REF Processing (Example 2)**

Settings of the second example shown in the figure
**P050 = 3**
**P051** = 1V; **P052** = 10V;
Vel_Min = **C028** = 1200 rpm; Vel_Max = **C029** = 400 rpm

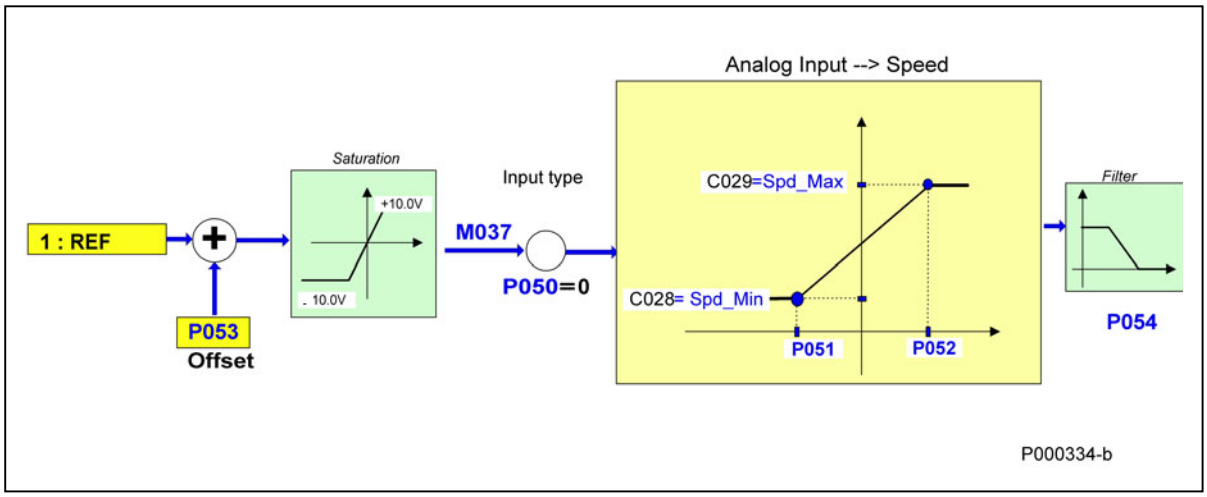



**Figure 12: Input REF Processing (Example 3)**

Settings of the example in the figure:
**P050** = 0
**P051** = –5V; **P052** = +8V;
**Vel_Min** = **C028** = 300 rpm; **Vel_Max** = **C029** =1450 rpm

## 12.3. List of Parameters from P050 to P074

Table 13: List of Parameters P050 ÷ P074

| Parameter | FUNCTION | Access Level | DEFAULT VALUE | MODBUS Address |
|---|---|---|---|---|
| P050 | Type of signal over **REF** input | ADVANCED | 3: 0÷10V | 650 |
| P051 | Value of **REF** input for generating min. reference | ADVANCED | 0.0V | 651 |
| P052 | Value of **REF** input for generating max. reference | ADVANCED | 10.0V | 652 |
| P053 | Value of Offset over **REF** input | ADVANCED | 0V | 653 |
| P054 | Filter time constant over **REF** input | ADVANCED | 5 ms | 654 |
| P055 | Type of signal over **AIN1** input | ADVANCED | 2: 4÷20mA | 655 |
| P056 | Value of **AIN1** input for generating min. reference | ADVANCED | 4.0mA | 656 |
| P057 | Value of **AIN1** input for generating max. reference | ADVANCED | 20.0mA | 657 |
| P058 | Value of Offset over **AIN1** input | ADVANCED | 0V | 658 |
| P059 | Filter time constant over **AIN1** input | ADVANCED | 5 ms | 659 |
| P060 | Type of signal over **AIN2** input | ADVANCED | 2: 4÷20mA | 660 |
| P061 | Value of **AIN2** input for generating min. reference | ADVANCED | 4.0mA | 661 |
| P062 | Value of **AIN2** input for generating max. reference | ADVANCED | 20.0mA | 662 |
| P063 | Value of Offset over **AIN2** input | ADVANCED | 0V | 663 |
| P064 | Filter time constant over **AIN2** input | ADVANCED | 5 ms | 664 |
| P065 | Minimum reference and threshold disable **START** | ADVANCED | 0 | 665 |
| P066 | Delay disable **START** at **P065** threshold | ADVANCED | 0 s | 666 |
| P067 | Ramp UP/DOWN keypad and terminal | ADVANCED | Quadratic | 667 |
| P068 | Storage of UP/DOWN at power off | ADVANCED | YES | 668 |
| P068a | Reset UP/DOWN Speed/Torque at stop | ADVANCED | 0:(NO) | 940 |
| P068b | Reset UP/DOWN PID at stop | ADVANCED | 0:(NO) | 941 |
| P068c | Reset UP/DOWN Speed/Torque at source change | ADVANCED | 0:(NO) | 942 |
| P068d | Reset UP/DOWN PID at source change | ADVANCED | 0:(NO) | 943 |
| P069 | Range of UP/DOWN reference | ADVANCED | 1:Unipolar | 669 |
| P070 | JOG reference (Speed/Torque) | ADVANCED | 0% | 670 |
| P071 | Value of **FIN** generating min. reference | ADVANCED | 10 kHz | 671 |
| P072 | Value of **FIN** generating max. reference | ADVANCED | 100 kHz | 672 |
| P073 | Value of **ECH** generating min. reference | ADVANCED | – 1500 rpm | 673 |
| P074 | Value of **ECH** generating max. reference | ADVANCED | +1500 rpm | 674 |

P050 Type of Signal over Input REF

| | | | |
|---|---|---|---|
| P050 | Range | 0 ÷ 4 | 0: ± 10 V<br>1: ± 20 mA<br>2: 4 ÷ 20 mA<br>3: 0 ÷ 10 V<br>4: 0 ÷ 20 mA |
| | Default | 3 | 3: 0 ÷ 10 V |
| | Level | ADVANCED | |
| | Address | 650 | |
| | Function | This parameter selects the type of single–ended, analog signal over terminal REF in the terminal board. The signal can be a voltage signal, a current signal, a unipolar signal, or a bipolar signal.<br>**0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values.<br><br>**1**: ± 20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values.<br><br>**2**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A066** or **A102** trip.<br><br>**3**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values.<br><br>**4**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values. | |

NOTE The value set in parameter **P050** must match with the status of switch **SW1–A** allowing to select the proper electric circuit for the analog signal processing (voltage signal or current signal).

P051 Value of Input REF generating Min. Reference

| | | | |
|---|---|---|---|
| P051 | Range | –100 ÷ 100, if **P050** = 0<br>–200 ÷ 200, if **P050** = 1<br>+40 ÷ 200, if **P050** = 2<br>0 ÷ 100, if **P050** = 3<br>0 ÷ 200, if **P050** = 4 | –10.0 V ÷ 10.0 V, if **P050** = 0: ± 10 V<br>–20.0 mA ÷ 20.0 mA, if **P050** = 1: ± 20 mA<br>+4.0mA ÷ 20.0 mA, if **P050** = 2: 4 ÷ 20 mA<br>0.0 V ÷ 10.0V, if **P050** = 3: 0 ÷ 10 V<br>0.0 mA ÷ 20.0 mA, if **P050** = 4: 0 ÷ 20 mA |
| | Default | 0 | 0 V |
| | Level | ADVANCED | |
| | Address | 651 | |
| | Function | This parameter selects the value for input REF signal for minimum reference, or better the reference set in **C028** (Master mode) or in **C047** (Slave mode). If motor 2 is active, **C071** and **C090** will be used instead of **C028** and **C047**; if motor 3 is active, the values set in **C114** and **C133** will be used. | |

P052 Value of Input REF generating Max. Reference

| | | | |
|---|---|---|---|
| P052 | Range | –100 ÷ 100, if P050 = 0<br>–200 ÷ 200, if P050 = 1<br>+40 ÷ 200, if P050 = 2<br>0 ÷ 100, if P050 = 3<br>0 ÷ 200, if P050 = 4 | –10.0 V ÷ 10.0 V, if P050 = 0: ± 10 V<br>–20.0 mA ÷ 20.0 mA, if P050 = 1: ± 20 mA<br>+4.0mA ÷ 20.0 mA, if P050 = 2: 4 ÷ 20 mA<br>0.0 V ÷ 10.0V, if P050 = 3: 0 ÷ 10 V<br>0.0 mA ÷ 20.0 mA, if P050 = 4: 0 ÷ 20 mA |
| | Default | 100 | 10.0 V |
| | Level | ADVANCED | |
| | Address | 652 | |
| | Function | This parameter selects the value for input REF signal for minimum reference, or better the reference set in C029 (Master mode) or in C048 (Slave mode). If motor 2 is active, C072 and C091 will be used instead of C029 and C048; if motor 3 is active, the values set in C115 and C134 will be used. | |

P053 Value of Offset over input REF

| | | | |
|---|---|---|---|
| P053 | Range | –2000 ÷ 2000 | –10.00 V ÷ +10.00 V, if P050 = 0 or 3<br>– 20.00 mA ÷ +20.00 mA, if P050 = 1,2,4 |
| | Default | 0 | 0 V |
| | Level | ADVANCED | |
| | Address | 653 | |
| | Function | This parameter selects the offset correction value of the analog signal REF that has been measured.<br>The value set is added to the signal measured before saturation or conversion (see Figure 10). | |

P054 Filtering time over analog input REF

| | | | |
|---|---|---|---|
| P054 | Range | 0 ÷ +65000 | 0 ÷ +65000ms |
| | Default | 5 | 5 ms |
| | Level | ADVANCED | |
| | Address | 653 | |
| | Function | This parameter selects the value of the filter time constant of the first command applied to the input REF signal when the signal saturation and conversion is over. | |

## P055 Type of signal over analog input AIN1

| | | | |
|---|---|---|---|
| P055 | Range | 0 ÷ 4 | 0: ± 10 V<br>1: ± 20 mA<br>2: 4 ÷ 20 mA<br>3: 0 ÷ 10 V<br>4: 0 ÷ 20 mA |
| | Default | 2 | 2: 4 ÷ 20 mA |
| | Level | ADVANCED | |
| | Address | 655 | |
| | Function | This parameter selects the type of differential analog signal over terminals **AIN1+** and **AIN1–** in the terminal board.<br>The signal can be a voltage signal, a current signal, a unipolar signal, or a bipolar signal.<br><br>**0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values.<br><br>**1**: ± 20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values.<br><br>**2**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A067** or **A103** trip.<br><br>**3**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values.<br><br>**4**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values. | |

NOTE The value set in parameter **P055** must match with the status of switch **SW1–B** allowing to select the proper electric circuit for the analog signal processing (voltage signal or current signal).

## P056 Value of input AIN1 for generating min. reference

| | | | |
|---|---|---|---|
| P056 | Range | –100 ÷ 100, if **P055** = 0<br>–200 ÷ 200, if **P055** = 1<br>+40 ÷ 200, if **P055** = 2<br>0 ÷ 100, if **P055** = 3<br>0 ÷ 200, if **P055**= 4 | –10.0 V ÷ 10.0 V, if **P055**= 0: ± 10 V<br>–20.0 mA ÷ 20.0 mA, if **P055** = 1: ± 20 mA<br>+4.0mA ÷ 20.0 mA, if **P055** = 2: 4 ÷ 20 mA<br>0.0 V ÷ 10.0V, if **P055** = 3: 0 ÷ 10 V<br>0.0 mA ÷ 20.0 mA, if **P055** = 4: 0 ÷ 20 mA |
| | Default | 40 | +4.0mA |
| | Level | ADVANCED | |
| | Address | 656 | |
| | Function | This parameter selects the value for input AIN1 signal for minimum reference, or better the reference set in **C028** (Master mode) or in **C047** (Slave mode). If motor 2 is active, **C071** and **C090** will be used instead of **C028** and **C047**; if motor 3 is active, the values set in **C114** and **C133** will be used. | |

P057 Value of input AIN1 for generating max. reference

| | | | |
|---|---|---|---|
| P057 | Range | –100 ÷ 100, if **P055** = 0<br>–200 ÷ 200, if **P055** = 1<br>+40 ÷ 200, if **P055** = 2<br>0 ÷ 100, if **P055** = 3<br>0 ÷ 200, if **P055** = 4 | –10.0 V ÷ 10.0 V, if **P055**= 0: ± 10 V<br>–20.0 mA ÷ 20.0 mA, if**P055** = 1: ± 20 mA<br>+4.0mA ÷ 20.0 mA, if **P055** = 2: 4 ÷ 20 mA<br>0.0 V ÷ 10.0V, if **P055** = 3: 0 ÷ 10 V<br>0.0 mA ÷ 20.0 mA, if **P055** = 4: 0 ÷ 20 mA |
| | Default | 200 | +20.0mA |
| | Level | ADVANCED | |
| | Address | 657 | |
| | Function | This parameter selects the value for input AIN1 signal for maximum reference, or better the reference set in **C029** (Master mode) or in **C048** (Slave mode). If motor 2 is active, **C072** and C091 will be used instead of **C029** and **C048**; if motor 3 is active, the values set in **C115** and **C134** will be used. | |

P058 Value of Offset over input AIN1

| | | | |
|---|---|---|---|
| P058 | Range | –2000 ÷ 2000 | –10.00 V ÷ +10.00 V, if **P055** = 0 or 3<br>– 20.00 mA ÷ +20.00 mA, if **P055** = 1,2,4 |
| | Default | 0 | 0 V |
| | Level | ADVANCED | |
| | Address | 658 | |
| | Function | This parameter selects the offset correction value of the analog signal AIN1 that has been measured.<br>The value set is added to the signal measured before saturation or conversion (see Figure 9). | |

P059 Filter time constant over anlaog input AIN1

| | | | |
|---|---|---|---|
| P059 | Range | 0 ÷ +65000 | 0 ÷ +65000ms |
| | Default | 5 | 5 ms |
| | Level | ADVANCED | |
| | Address | 659 | |
| | Function | This parameter selects the value of the filter time constant of the first command applied to the input AIN1 signal when the signal saturation and conversion is over. | |

## P060 Type of signal over analog input AIN2

| | | | |
|---|---|---|---|
| **P060** | Range | 0 ÷ 4 | 0: ± 10 V<br>1: ± 20 mA<br>2: 4 ÷ 20 mA<br>3: 0 ÷ 10 V<br>4: 0 ÷ 20 mA |
| | Default | 3 | 2: 4 ÷ 20 mA |
| | Level | ADVANCED | |
| | Address | 660 | |
| | Function | This parameter selects the type of differential analog signal over terminals **AIN2+** and **AIN2–** in the terminal board.<br>The signal can be a voltage signal, a current signal, a unipolar signal, or a bipolar signal.<br><br>**0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values.<br><br>**1**: ± 20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values.<br><br>**2**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A068** or **A104** trip.<br><br>**3**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values.<br><br>**4**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values. | |

NOTE The value set in parameter **P060** must match with the status of switches **SW1–C** and **SW1-E** allowing to select the proper electric circuit for the analog signal processing (voltage signal or current signal).

## P061 Value of input AIN2 for generating min. reference

| | | | |
|---|---|---|---|
| **P061** | Range | –100 ÷ 100, if **P060** = 0<br>–200 ÷ 200, if **P060** = 1<br>+40 ÷ 200, if **P060** = 2<br>0 ÷ 100, if **P060** = 3<br>0 ÷ 200, if **P060**= 4 | –10.0 V ÷ 10.0 V, if **P060**= 0: ± 10 V<br>–20.0 mA ÷ 20.0 mA, if **P060** = 1: ± 20 mA<br>+4.0mA ÷ 20.0 mA, if **P060** = 2: 4 ÷ 20 mA<br>0.0 V ÷ 10.0V, if **P060** = 3: 0 ÷ 10 V<br>0.0 mA ÷ 20.0 mA , if **P060** = 4: 0 ÷ 20 mA |
| | Default | 40 | +4.0mA |
| | Level | ADVANCED | |
| | Address | 661 | |
| | Function | This parameter selects the value for input AIN2 signal for minimum reference, or better the reference set in **C028** (Master mode) or in **C047** (Slave mode). If motor 2 is active, **C071** and **C090** will be used instead of **C028** and **C047**; if motor 3 is active, the values set in **C114** and **C133** will be used. | |

P062 Value of input AIN2 for generating max. reference

| | | | |
|---|---|---|---|
| P062 | Range | –100 ÷ 100, if P060 = 0<br>–200 ÷ 200, if P060 = 1<br>+40 ÷ 200, if P060 = 2<br>0 ÷ 100, if P060 = 3<br>0 ÷ 200, if P060= 4 | –10.0 V ÷ 10.0 V, if P060= 0: ± 10 V<br>–20.0 mA ÷ 20.0 mA, if P060 = 1: ± 20 mA<br>+4.0mA ÷ 20.0 mA, if P060 = 2: 4 ÷ 20 mA<br>0.0 V ÷ 10.0V, if P060 = 3: 0 ÷ 10 V<br>0.0 mA ÷ 20.0 mA, if P060 = 4: 0 ÷ 20 mA |
| | Default | 200 | +20.0 mA |
| | Level | ADVANCED | |
| | Address | 662 | |
| | Function | This parameter selects the value for input AIN1 signal for maximum reference, or better the reference set in C029 (Master mode) or in C048 (Slave mode). If motor 2 is active, C072 and C091 will be used instead of C029 and C048; if motor 3 is active, the values set in C115 and C134 will be used. | |

P063 Value of Offset over input AIN2

| | | | |
|---|---|---|---|
| P063 | Range | –2000 ÷ 2000 | –10.00 V ÷ +10.00 V, if P060 = 0 o 3<br>– 20.00 mA ÷ +20,00 mA , if P060 = 1,2,4 |
| | Default | 0 | 0 V |
| | Level | ADVANCED | |
| | Address | 663 | |
| | Function | This parameter selects the offset correction value of the analog signal AIN2 that has been measured.<br>The value set is added to the signal measured before saturation or conversion. | |

P064 Filter time constant over analog input AIN2

| | | | |
|---|---|---|---|
| P064 | Range | 0 ÷ +65000 | 0 ÷ +65000ms |
| | Default | 5 | 5 ms |
| | Level | ADVANCED | |
| | Address | 664 | |
| | Function | This parameter selects the value of the filter time constant of the first command applied to the input AIN2 signal when the signal saturation and conversion is over. | |

P065 Minimum reference and threshold disable START

| | | | |
|---|---|---|---|
| P065 | Range | 0 ÷ +32000 | 0 ÷ +32000 rpm |
| | Default | 0 | 0rpm |
| | Level | ADVANCED | |
| | Address | 665 | |
| | Function | If this parameter is other than zero, the current speed reference computed when processing of all active source reference is over, **it is saturated as an absolute value of this parameter's value**.<br>Saturation implies an absolute value, i.e. this parameter determines a "prohibit range" of the reference approx. zero.<br>Example: *P065 = 100 rpm and current speed reference is 500 rpm; if reference drops below 100 rpm, for example reaching+50rpm , the value of the active reference is saturated to 100 rpm until reference exceeds 100 rpm again or is lower than–100 rpm; in that case, the preset value will be assigned to the reference.*<br>If also parameter **P066** is other than zero, the **inverter disabling function is enabled**: if the absolute value of the current speed reference is kept in the "prohibit range" for a time longer than the time set in **P066**, reference is set to zero and the motor speed decreases following the active ramp up to zero rpm; when the motor speed is equal to zero, the inverter will automatically deactivate.<br>**The inverter will automatically reactivate** if the reference exceeds the value set in parameter **P065** as an absolute value. | |

NOTE Parameter **P065** is active in Master mode only, i.e. with a speed reference.

NOTE Parameter **P065** is active only when the Speed searching and Power Down functions are disabled: **C245**=0 and **C225**=0.

P066 Delay disable START at P065 threshold

| P066 | | | |
|---|---|---|---|
| | Range | 0 ÷ 250 | 0 ÷ 250 sec |
| | Default | 0 | 0: Disabled |
| | Level | ADVANCED | |
| | Address | 666 | |
| | Function | If this parameter is other than zero and if also parameter **P065** is other than zero, the **inverter disabling function is enabled**: if the absolute value of the current speed reference is kept in the "prohibit range" for a time longer than the time set in **P066**, reference is set to zero and the motor speed decreases following the active ramp up to zero rpm; when the motor speed is equal to zero, the inverter will automatically deactivate.<br>See also the description of parameter **P065**. | |

P067 UP/DOWN Ramp from keypad and terminal

| P067 | | | |
|---|---|---|---|
| | Range | 0 ÷ 6501 | 0 sec ÷ 6500s Quadratic |
| | Default | 6501 | Quadratic |
| | Level | ADVANCED | |
| | Address | 667 | |
| | Function | Reference may be increased or decreased with input digital signals **UP** and **DOWN**, or with **INC** and **DEC** keys in the keypad (local mode).<br>Reference increment or decrement is obtained by adding to the current reference a quantity which will be increased or decreased with a time ramp.<br>Parameter **P067** indicates the ramp time to increase the reference from zero to the preset speed (or torque) maximum absolute value, i.e. the max. value between absolute values Vel_Min and Vel_Max (or Trq_Min and Trq_Max).<br>If motor 1 is active, Vel_Min=**C028**, Vel_Max=**C029**, Trq_Min=**C047**, Trq_Max=**C048**. | |

P068 Storage of UP/DOWN at power off

| P068 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: Disabled, 1: Enabled |
| | Default | 1 | 1: Enabled |
| | Level | ADVANCED | |
| | Address | 668 | |
| | Function | If **P068**=1, the Speed/Torque or PID references added through input digital signals **UP** and **DOWN** or with the **INC** and **DEC** keys (local mode), are stored at the inverter power off and added to the start reference when the inverter is restarted.<br>This function allows storing the reference value obtained with **UP** and **DOWN** signals. | |

P068a Reset UP/DOWN Speed/Torque at stop

| P068a | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: NO, 1: YES |
| | Default | 0 | 0: NO |
| | Level | ADVANCED | |
| | Address | 940 | |
| | Function | If **P068a** =1:[Yes], the Speed/Torque reference given by **UP/DOWN** (from digital signals **UP** and **DOWN** or with the ▲ and ▼ keys on the keypad) returns to zero each time the **START** is removed from the inverter and terminates the deceleration ramp. | |

P068b Reset UP/DOWN PID at stop

| P068b | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: NO, 1: YES |
| | Default | 0 | 0: NO |
| | Level | ADVANCED | |
| | Address | 941 | |
| | Function | Se **P068b** =1:[Yes], the PID reference given by **UP/DOWN** (from digital signals **UP** and **DOWN** or with the ▲ and ▼ keys on the keypad) returns to zero each time the **START** is removed from the inverter and terminates the deceleration ramp. | |

P068c Reset UP/DOWN Speed/Torque at source change

| P068c | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: NO, 1: YES |
| | Default | 0 | 0: NO |
| | Level | ADVANCED | |
| | Address | 942 | |
| | Function | Se **P068c** =1:[Yes], the Speed/Torque reference given by **UP/DOWN** (from digital signals **UP** and **DOWN** or with the ▲ and ▼ keys on the keypad) returns to zero each time the command source is changed from Remote to Local and vice versa using the **LOC/REM** key or digital input, or when the command source switch is effected using the programmed digital input in **C179** (MDI for source selection - see DIGITAL INPUTS MENU). | |

P068d Reset UP/DOWN PID at source change

| P068d | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: NO, 1: YES |
| | Default | 0 | 0: NO |
| | Level | ADVANCED | |
| | Address | 943 | |
| | Function | Se **P068d** =1:[Yes], the PID reference given by **UP/DOWN** (from digital signals **UP** and **DOWN** or with the ▲ and ▼ keys on the keypad) returns to zero each time the command source is changed from Remote to Local and vice versa using the **LOC/REM** key or digital input, or when the command source switch is effected using the programmed digital input in **C179** (MDI for source selection - see DIGITAL INPUTS MENU). | |

P069 Range of UP/DOWN reference

| P069 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: Bipolar, 1: Unipolar |
| | Default | 1 | 1: Unipolar |
| | Level | ADVANCED | |
| | Address | 669 | |
| | Function | If **P069**=1, the quantity added through input digital signals **UP** and **DOWN** or with the ▲ and ▼ keys (local mode), is unipolar, i.e. it is positive only and has a min. value equal to zero.<br>For bipolar quantities, the added quantity may be negative. | |

P070 JOG reference (Speed/Torque)

| P070 | | | |
|---|---|---|---|
| | Range | ± 100 | ± 100 % |
| | Default | 0 | 0 % |
| | Level | ADVANCED | |
| | Address | 670 | |
| | Function | Value of the JOG reference. For speed control, the percentage of the jog reference relates to the maximum speed value of the selected motor (max. value as an absolute value between min. and max. speed parameters); in case of torque control, the percentage of the jog reference relates to the torque max. value of the selected motor (max. value as an absolute value between min. and max. torque limit). | |

P071 Value of FIN generating min. reference

| P071 | | | |
|---|---|---|---|
| | Range | 1000 ÷ 10000 | 10 kHz ÷ 100 kHz |
| | Default | 1000 | 10 kHz |
| | Level | ADVANCED | |
| | Address | 671 | |
| | Function | This parameter selects the value of the **frequency input** signal for minimum reference, or better the reference set in **C028** (Master mode) or in **C047** (Slave mode). If motor 2 is active, **C071** and **C090** will be used instead of **C028** and **C047**; if motor 3 is active, the values set in **C114** and **C133** will be used. | |

P072 Value of FIN generating max. reference

| P072 | | | |
|---|---|---|---|
| | Range | 1000 ÷ 10000 | 10 kHz ÷ 100 kHz |
| | Default | 10000 | 100 kHz |
| | Level | ADVANCED | |
| | Address | 672 | |
| | Function | This parameter selects the value of the **frequency input** signal for maximum reference, or better the reference set in **C029** (Master mode) or in **C048** (Slave mode). If motor 2 is active, **C071** and **C090** will be used instead of **C029** and **C048**; if motor 3 is active, the values set in **C115** and **C134** will be used. | |

P073 Value of ECH generating min. reference

| P073 | | | |
|---|---|---|---|
| | Range | –32000 ÷ 32000 | ± 32000 rpm |
| | Default | –1500 | –1500 rpm |
| | Level | ADVANCED | |
| | Address | 673 | |
| | Function | This parameter selects the value of the **Encoder input** for minimum reference, or better the reference set in **C028** (Master mode) or in **C047** (Slave mode). If motor 2 is active, the values set in **C071** and **C090** will be used instead of **C028** and **C047**; if motor 3 is active, the values set in **C114** and **C133** will be used. | |

P074 Value of ECH generating max. reference

| P074 | | | |
|---|---|---|---|
| | Range | –32000 ÷ 32000 | ± 32000 rpm |
| | Default | +1500 | +1500 rpm |
| | Level | ADVANCED | |
| | Address | 674 | |
| | Function | This parameter selects the value of the **Encoder input** for maximum reference, or better the reference set in **C028** (Master mode) or in **C047** (Slave mode). If motor 2 is active, **C071** and **C090** will be used instead of **C028** and **C047**; if motor 3 is active, the values set in **C114** and **C133** will be used. | |

# 13. MULTISPEED MENU

## 13.1. Overview

NOTE See also INPUT REFERENCES MENU and DIGITAL INPUTS MENU.

The Preset Speed menu allows defining the values for 15 **preset speed** (or **multispeed**) references set in parameters **P081÷ P098**. Their application method is set in **P080**.
The desired speed is selected through the digital inputs described in the previous section, relating to the **Digital Inputs Menu**.
The programmable reference range using these parameters is:

- ± 32000 rpm if multispeed unit of measure is → **P100** = 1.00 rpm
- ± 3200.0 rpm if multispeed unit of measure is → **P100** = 0.10 rpm
- ± 320.00 rpm if multispeed unit of measure is → **P100** = 0.01 rpm

Use parameters C155, C156, C157 and C158 to set the digital inputs in multispeed mode.
Parameter **P080** defines the functionality of the references set in the preset speed function: PRESET SPEED, EXCLUSIVE PRESET SPEED, SUM SPEED.
If **P080** = **PRESET SPEED**, the speed reference is the value set in the preset speed which is active at that moment. If digital inputs set as **multispeed** are all open (inactive), the speed reference is the reference coming from the sources selected in the **Control Method Menu** (**C143** ÷ **C146**).
If **P080** = **EXCLUSIVE PRESET SPEED**, the speed reference is the value set in the multispeed which is active at that moment. If digital inputs set as **multispeed** are all open (inactive), no other reference source is considered; speed reference is zero.
If **P080** = **SUM SPEED**, the speed reference value assigned to the **preset speed** which is active at that moment is summed up to the total amount of the speed references.

**The reference obtained is always saturated by the parameters relating to the min. speed and the max. speed of the selected motor.**

## 13.2. List of Parameters from P080 to P100

Table 14: List of Parameters P080 ÷ P100

| Parameter | FUNCTION | Access Level | DEFAULT | MODBUS Address |
|---|---|---|---|---|
| P080 | Multispeed function | BASIC | 0:Preset Speed | 680 |
| P081 | Output speed Mspd1 | BASIC | 0.00 rpm | 681 |
| P083 | Output speed Mspd2 | BASIC | 0.00 rpm | 683 |
| P085 | Output speed Mspd3 | BASIC | 0 rpm | 685 |
| P087 | Output speed Mspd4 | ADVANCED | 0 rpm | 687 |
| P088 | Output speed Mspd5 | ADVANCED | 0 rpm | 688 |
| P089 | Output speed Mspd6 | ADVANCED | 0 rpm | 689 |
| P090 | Output speed Mspd7 | ADVANCED | 0 rpm | 690 |
| P091 | Output speed Mspd8 | ADVANCED | 0 rpm | 691 |
| P092 | Output speed Mspd9 | ADVANCED | 0 rpm | 692 |
| P093 | Output speed Mspd10 | ADVANCED | 0 rpm | 693 |
| P094 | Output speed Mspd 11 | ADVANCED | 0 rpm | 694 |
| P095 | Output speed Mspd 12 | ADVANCED | 0 rpm | 695 |
| P096 | Output speed Mspd 13 | ADVANCED | 0 rpm | 696 |
| P097 | Output speed Mspd 14 | ADVANCED | 0 rpm | 697 |
| P098 | Output speed Mspd 15 | ADVANCED | 0 rpm | 698 |
| P099 | Fire Mode Speed | ENGINEERING | 800 rpm | 699 |
| P100 | Multispeed Unit of Measure | ADVANCED | 2: 1.0 rpm | 700 |

P080 Multispeed Function

| P080 | Range | 0 ÷ 2 | 0: Preset Speed,<br>1: Sum Speed,<br>2: Exclusive Preset Speed |
|---|---|---|---|
| | Default | 0 | 0: Preset Speed |
| | Level | BASIC | |
| | Address | 680 | |
| | Function | Defines the functionality of the multispeed values for the global speed reference. Three functions are available:<br>• 0: [ Preset Speed ] → the selected **multispeed** is the actual rpm value (upon limit due to min. and max. speed parameters for the selected motor) of the motor speed reference. If no **multispeed** is selected (*no digital input programmed for multispeed selection is activated, or all digital inputs programmed for multispeed selection are deactivated*), the speed reference is the reference for the sources set in the **Control Method Menu**.<br>• 1: [ Sum Speed ] → the reference relating to the selected multispeed is considered as the sum of the references for the other reference sources selected in the Control Method Menu.<br>• 2: [ Exclusive Preset Speed ] → the selected multispeed is the actual rpm value (upon saturation due to min. and max. speed parameters for the selected motor) of the motor speed reference. Unlike function 0 [Preset Speed], if no multispeed is selected (*no digital input programmed for multispeed selection is activated, or all digital inputs programmed for multispeed selection are deactivated*) **the speed reference is zero**. | |

P081÷P098 Programmed Speed n.1 (/15)

| P081÷P098 | Range | –32000 ÷ 32000 | ±32000 rpm |
|---|---|---|---|
| | Default | 0 | 0.00 rpm |
| | Level | From **P081** to **P086** BASIC<br>From **P087** to **P098** ADVANCED | |
| | Address | 681÷698 | |
| | Function | Determines the value of the output speed for the selection of multispeed effected with the relative digital inputs (see Table 63). The multispeed value is scaled based on the programmed unit of measure in **P100**.<br>This multispeed reference selected via the digital inputs will be processed based on setting in **P080**. | |

## P099 Fire Mode Speed

| P099 | | | |
|---|---|---|---|
| | Range | –32000 ÷ 32000 | ±32000 rpm |
| | Default | 0 | 0.00 rpm |
| | Level | ENGINEERING | |
| | Address | 699 | |
| | Function | Determines the value of the output speed in Fire Mode. The Fire Mode speed is function of the unit of measure programmed in **P100**. | |

## P100 Multispeed Unit of Measure

| P100 | | | |
|---|---|---|---|
| | Range | 0 ÷ 2 | 0: (0.01 rpm) ÷ 2: (1.0 rpm) |
| | Default | 2 | 2: (1.0 rpm) |
| | Level | BASIC | |
| | Address | 700 | |
| | Function | Determines the unit of measure considered for the 15 multispeed values and the Fire Mode speed in **P099**. | |

CAUTION

If the unit of measure of the multispeed values in **P100** is modified, the programmed speed values for the multispeed and Fire Mode values will be RECOMPUTED.

# 14. PROHIBIT SPEED MENU

## 14.1. Overview

This menu allows to set prohibit speed ranges that the motor may maintain constant due to problems with mechanical resonance.
Three prohibit speed ranges are available: 3 intermediate values of the speed range and their semi amplitude (one for all ranges).
In this way, the speed reference value is never included in one of the preset speed ranges; when decreasing, if the speed reference matches with the max. allowable value of a prohibit speed range, the value assigned to the reference is given by the min. allowable value of the speed range, and vice versa when the reference is increasing.
The discontinuity of the speed reference has no effect on the actual speed of the connected motor, because it will vary with continuity until it reaches the new rpm value of the speed reference.
The intermediate values of the prohibit speed ranges are to be intended as absolute values (independent of the reference sign, +/-).

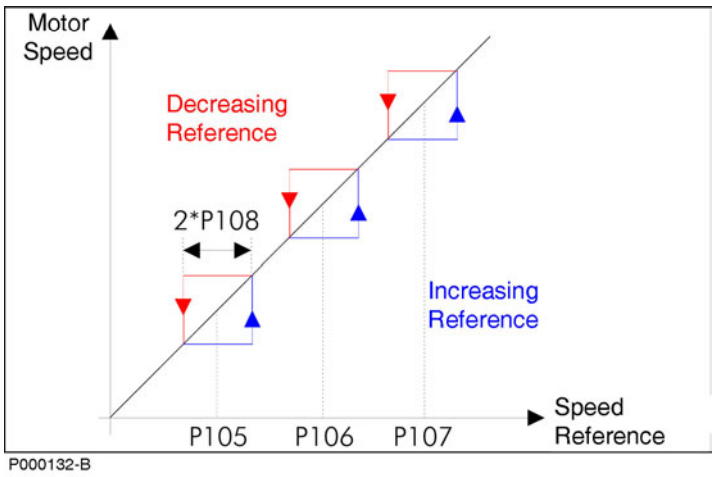



Figure 13: Prohibit Speed Ranges

Figure 11 illustrates different trends of the speed reference when it matches with the max. allowable value of a prohibit speed range when decreasing (red) or when it matches with the min. allowable value of a prohibit speed range when increasing (blue).

Example:

**P105** = 500 rpmProhibit speed 1
**P106** = 650 rpmProhibit speed 2
**P107** = 700 rpmProhibit speed 3
**P108** = 50 rpmSemi amplitude of prohibit speed ranges

| Range Number | Min. Allowable Value | Max. Allowable Value |
|---|---|---|
| 1 | 450 rpm | 550 rpm |
| 2 | 600 rpm | 700 rpm |
| 3 | 650 rpm | 750 rpm |

In this case, the second and third prohibit ranges partially match, because the max. allowable value of the second range (700 rpm) is higher than the min. allowable value of the third range (650 rpm); thus forming one prohibit speed range ranging from 600 rpm to 750 rpm.

## 14.2. List of Parameters from P105 to P108

Table 15: List of Parameters P105 ÷ P108

| Parameter | FUNCTION | Access Level | MODBUS Address |
|---|---|---|---|
| P105 | Prohibit speed 1 | ADVANCED | 705 |
| P106 | Prohibit speed 2 | ADVANCED | 706 |
| P107 | Prohibit speed 3 | ADVANCED | 707 |
| P108 | Hysteresis (band) of prohibit speed ranges | ADVANCED | 708 |

P105 (P106,P107) Prohibit Speed 1

| P105 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32000 | 0 ÷ 32000 rpm |
| | Default | 0 | 0 rpm |
| | Level | ADVANCED | |
| | Address | 705<br>706<br>707 | |
| | Function | Determines the intermediate value of the first prohibit speed range. This value is to be considered as an absolute value, i.e. independent of the speed reference sign (+/-). | |

P108 Semi amplitude of Prohibit Speed Ranges

| P108 | | | |
|---|---|---|---|
| | Range | 0 ÷ 5000 | 0 ÷ 5000 rpm |
| | Default | 0 | 0 rpm |
| | Level | ADVANCED | |
| | Address | 708 | |
| | Function | Determines the semi amplitude of the prohibit speed ranges. | |

# 15. PERCENT VARIATION OF REFERENCE MENU

## 15.1. Overview

In the Percent Variation of Reference menu, it is possible to define the variation values of the speed/torque instant reference to be entered through digital inputs that have been properly programmed.
As per the selection of the variation percentage programmed to the reference and given by the combination of digital inputs configured with parameters **C175 ÷ C177**, please refer to the **Digital Inputs Menu**.
The parameters included in this menu represent seven speed/torque variation possibilities to be applied to the speed reference.
Variation may range from **–100.0% to 100.0%** of the instant reference given by the addition of all selected sources (measure **M00**).

Example:

| | | |
|---|---|---|
| **P115=** | 0.0% | Variation percentage of reference 1 |
| **P116=** | 50.0% | Variation percentage of reference 2 |
| **P117=** | –80.0% | Variation percentage of reference 3 |

Based on the speed/torque variation selected through digital inputs, the speed reference at constant speed will be the following:

Variation 1: the current reference without modifications (no effect).
Variation 2: the current reference increased by 50.0%.
Variation 3: the current reference decreased by 80.0%.

Speed control (example)

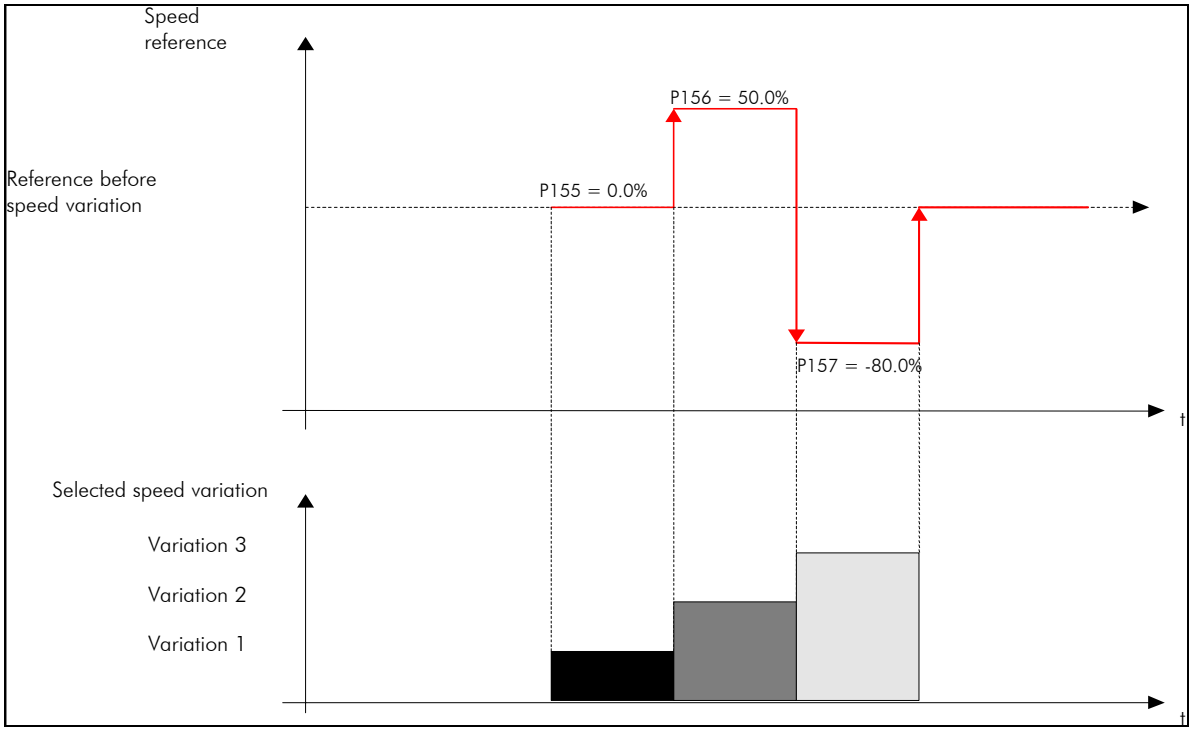



**Figure 14: Speed Control (Example)**

NOTE

Whatever the speed/torque reference value resulting from the application of a speed variation, the value used to control the motor is saturated at max. and min. speed/torque values set in the parameters relating to the selected motor.

## 15.2. List of Parameters from P115 to P121

Table 16: List of Parameters P115 ÷ P121

| Parameter | FUNCTION | Access Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| P115 | Variation percentage of reference 1 | ENGINEERING | 0.0% | 715 |
| P116 | Variation percentage of reference 2 | ENGINEERING | 0.0% | 716 |
| P117 | Variation percentage of reference 3 | ENGINEERING | 0.0% | 717 |
| P118 | Variation percentage of reference 4 | ENGINEERING | 0.0% | 718 |
| P119 | Variation percentage of reference 5 | ENGINEERING | 0.0% | 719 |
| P120 | Variation percentage of reference 6 | ENGINEERING | 0.0% | 720 |
| P121 | Variation percentage of reference 7 | ENGINEERING | 0.0% | 721 |

P115 (÷ P121) Variation percentage n.1 (÷n.7) of Reference

| P115 (÷ P121) | | | |
|---|---|---|---|
| | Range | ±1000 | ±100.0% |
| | Default | 0 | 0.0% |
| | Level | ENGINEERING | |
| | Address | 715 (÷721) | |
| | Function | These parameters define the variation percentage of the current reference (M000 for speed control, M007 for torque control) to be considered as a ramp reference when selecting variation percentage 1 (÷7). | |

# 16. SPEED LOOP AND CURRENT BALANCING MENU

## 16.1. Overview

In the Speed Loop and Current Balancing menu, for VTC and FOC controls, it is possible to set the parameter values of the speed regulators for the three connected motors. In addition, this menu gives the possibility to effect manual balancing of the motor currents (see **P152**).
The speed regulator for each motor has two parameterization functions: two integral terms, two proportional terms and two speed error thresholds (expressed as a percentage of the motor rated speed).
The response of the speed regulator can be dynamically linked with the speed error; in this way, the speed regulator will be more sensitive to remarkable speed errors and less sensitive to negligible speed errors.
Factory setting: because two identical error thresholds are set, only two parameters are used: **max. integral time** and **min. proportional constant**.
The setup of min. integral time and max. proportional constant is enabled provided that two different error thresholds are used.

Example:

| | | | |
|---|---|---|---|
| **P125** | 500 | [ms] | Minimum integral time |
| **P126** | 100 | [ms] | Maximum integral time |
| **P128** | 10.00 | | Minimum proportional constant |
| **P129** | 25.00 | | Maximum proportional constant |
| **P130** | 2 | [%] | Minimum error threshold |
| **P131** | 20 | [%] | Maximum error threshold |

Error ≤ **P130**
For speed **errors** lower than or equal to 2% of the motor rated speed, the speed regulator adopts the min. coefficients, i.e. parameters **P126** (determining the lesser integral coefficient 1/**P126** ) and **P128**.
Error ≥ **P131**
If the speed error exceeds the second error threshold, the speed regulator shall quickly make up for the greater error, so it uses the highest coefficients, i.e. **P125** (determining the greater integral coefficient 1/**P125** ) and **P129**.
**P130**<Error<**P131**
When the speed error is included between the two error thresholds, the speed regulator will use coefficients that are dynamically linked with the speed error (see figure below).

Integral coefficient = (1/**P126**) + [(err%–**P130**)* (1/**P125** – 1/**P126** ) / ( **P131** – **P130** )]
Proportional coefficient = **P128** + [(err%–**P130**)* ( **P129** – **P128** ) / ( **P131** – **P130** )]

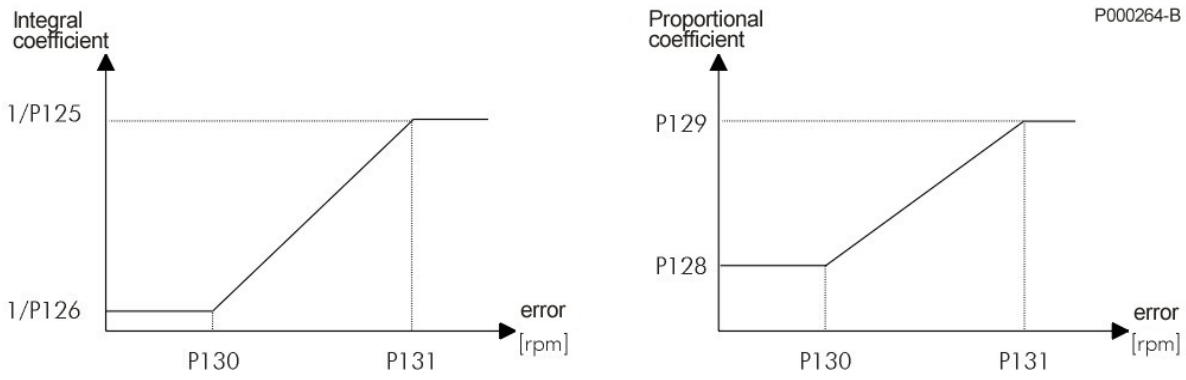



Figure 15: Dual Parameterization Function (Example)

## 16.2. List of Parameters from P125 to P152

Table 17: List of Parameters P125 ÷ P152

| Parameter | FUNCTION | Access Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| P125 | Mot1 Min. integral time | BASIC | 500 ms | 725 |
| P126 | Mot1 Max. integral time | BASIC | 500 ms | 726 |
| P128 | Mot1 Min. prop. coefficient | BASIC | 10.00 | 728 |
| P129 | Mot1 Max. prop. coefficient | BASIC | 10.00 | 729 |
| P130 | Mot1 Min. error threshold | BASIC | 1.00% | 730 |
| P131 | Mot1 Max. error threshold | BASIC | 1.00% | 731 |
| P135 | Mot2 Min. integral time | BASIC | 500 ms | 735 |
| P136 | Mot2 Max. integral time | BASIC | 500 ms | 736 |
| P138 | Mot2 Min. prop. coefficient | BASIC | 10.00 | 738 |
| P139 | Mot2 Max. prop. coefficient | BASIC | 10.00 | 739 |
| P140 | Mot2 Min. error threshold | BASIC | 1.00% | 740 |
| P141 | Mot2 Max. error threshold | BASIC | 1.00% | 741 |
| P145 | Mot3 Min. integral time | BASIC | 500 ms | 745 |
| P146 | Mot3 Max. integral time | BASIC | 500 ms | 746 |
| P148 | Mot3 Min. prop. coefficient | BASIC | 10.00 | 748 |
| P149 | Mot3 Max. prop. coefficient | BASIC | 10.00 | 749 |
| P150 | Mot3 Min. error threshold | BASIC | 1.00% | 750 |
| P151 | Mot3 Max. error threshold | BASIC | 1.00% | 751 |
| P152 | Symmetry regulation of three-phase current | ENGINEERING | 0% | 752 |

P125 (P135, P145) Min. Integral Time

| P125(motor n.1)<br>P135 (motor n.2)<br>P145 (motor n.3) | | | |
|---|---|---|---|
| | Range | 1÷ 32000 | 0.001÷ 32.000 [Disable] ms |
| | Default | 500 | 500 ms |
| | Level | BASIC | |
| | Address | 725<br>735<br>745 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the min. integral time for the speed regulator. It may be accessed only if the min. and max. error thresholds are different (**P130≠P131** for Motor1, **P140≠P141** for Motor2, **P150≠P151** for Motor3). | |

P126 (P136, P146) Max. Integral Time

| P126(motor n.1)<br>P136 (motor n.2)<br>P146 (motor n.3) | | | |
|---|---|---|---|
| | Range | 1÷ 32000 | 0.001÷ 32.000 [Disable] ms |
| | Default | 500 | 500 ms |
| | Level | BASIC | |
| | Address | 726<br>736<br>746 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the max. integral time for the speed regulator. | |

## P128 (P138, P148) Min. Proportional Coefficient

| | | | |
|---|---|---|---|
| P128(motor n.1)<br>P138 (motor n.2)<br>P148 (motor n.3) | Range | 0 ÷ 65000 | 0.00 ÷ 650.00 |
| | Default | 1000 | 10.00 |
| | Level | BASIC | |
| | Address | 728,738,748 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the min. proportional coefficient for the speed regulator. Default value (10): if a speed error of 1% occurs, the regulator will require 10% of the motor rated torque. | |

## P129 (P139, P149) Max. Proportional coefficient

| | | | |
|---|---|---|---|
| P129(motor n.1)<br>P139 (motor n.2)<br>P149 (motor n.3) | Range | 0 ÷ 65000 | 0.00 ÷ 650.00 |
| | Default | 1000 | 10.00 |
| | Level | BASIC | |
| | Address | 729,739,749 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the max. proportional coefficient for the speed regulator. Default value (10): if a speed error of 1% occurs, the regulator will require 10% of the motor rated torque. This parameter may be accessed only if the min. and max. error thresholds are different (P130 ≠ P131 for Motor1, P140 ≠ P141 for Motor2, P150 ≠ P151 for Motor3). | |

## P130 (P140, P150) Min. Error Threshold

| | | | |
|---|---|---|---|
| P130(motor n.1)<br>P140 (motor n.2)<br>P150 (motor n.3) | Range | 0 ÷ 32000 | 0.00 ÷ 320.00 |
| | Default | 100 | 1.00% |
| | Level | BASIC | |
| | Address | 730,740,750 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the min. error threshold.<br>In case of speed errors lower than or equal to the min. threshold, parameters P126 and P128 will be used. | |

## P131 (P141, P151) Max. Error Threshold

| | | | |
|---|---|---|---|
| P131<br>P141 (motor n.2)<br>P151 (motor n.3) | Range | 0 ÷ 32000 | 0.00 ÷ 320.00 |
| | Default | 100 | 1.00% |
| | Level | BASIC | |
| | Address | 731,741,751 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the max. error threshold.<br>If P130 = P131 or in case of speed errors greater than or equal to the max. threshold, parameters P125 and P129 will be used. | |

## P152 Symmetry regulation of three-phase current

| | | | |
|---|---|---|---|
| P152 | Range | ± 100 | ± 100% |
| | Default | 0 | 0% |
| | Level | ENGINEERING | |
| | Address | 752 | |
| | Function | Influences on the balancing of the three-phase current.<br>To be used in cases where there is dissymmetry of motor currents that is especially evident in no-load current and low speeds. | |

# 17. FOC REGULATORS MENU

## 17.1. Overview

NOTE Please refer to **Motor Control** section as well.

NOTE This menu may be accessed only if the FOC control is programmed for one of the connected motors (**C010**=2 for motor n.1, **C053**=2 for motor n.2, **C096**=2 for motor n.3).

The FOC control has the same basic structure as that of any classic field oriented control.
The inner loops of FOC control are **two current regulators PI** having the same parameters.
The first regulator controls **torque current Iq**; the second regulator controls **flux current Id**.
Torque current **Iq** is computed based on the required torque set-point.
In **Slave mode** (torque reference), the required set–point comes from the external reference; in **Master mode,** the torque set–point is given by the output of the **speed regulator** (see SPEED LOOP AND CURRENT BALANCING MENU) for the regulation of the motor speed of rotation.
Flux current **Id** results from the output of the **flux regulator**, ensuring that the connected motor is always properly fluxed.
This menu allows to access the current PI regulators and flux regulators for the FOC control.

## 17.2. List of Parameters from P155 to P173

Table 18: List of Parameters P155 ÷ P173

| Parameter | FUNCTION | Access Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| P155 | Current Regulator Proportional Constant, Mot n.1 | ENGINEERING | 3.00 | 755 |
| P156 | Current Regulator Integral Time, Mot n.1 | ENGINEERING | 20.0 ms | 756 |
| P158 | Flux Regulator Proportional Constant, Mot n.1 | ENGINEERING | 3.00 | 758 |
| P159 | Flux Regulator Integral Time, Mot n.1 | ENGINEERING | 200 ms | 759 |
| P162 | Current Regulator Proportional Constant, Mot n.2 | ENGINEERING | 3.00 | 762 |
| P163 | Current Regulator Integral Time, Mot n.2 | ENGINEERING | 20.0 ms | 763 |
| P165 | Flux Regulator Proportional Constant, Mot n.2 | ENGINEERING | 3.00 | 765 |
| P166 | Flux Regulator Integral Time, Mot n.2 | ENGINEERING | 200 ms | 766 |
| P169 | Current Regulator Proportional Constant, Mot n.3 | ENGINEERING | 3.00 | 769 |
| P170 | Current Regulator Integral Time, Mot n.3 | ENGINEERING | 20.0 ms | 770 |
| P172 | Flux Regulator Proportional Constant, Mot n.3 | ENGINEERING | 3.00 | 772 |
| P173 | Flux Regulator Integral Time, Mot n.3 | ENGINEERING | 200 ms | 773 |

## P155 (P162, P169) Current Regulator Proportional Constant

| | | | |
|---|---|---|---|
| **P155(motor n.1)<br>P162 (motor n.2)<br>P169 (motor n.3)** | **Range** | 0 ÷ 65000 | 0.00 ÷ 650.00 |
| | **Default** | 300 | 3.00 |
| | **Level** | ENGINEERING | |
| | **Address** | 755<br>762 (motor n.2)<br>769 (motor n.3) | |
| | **Control** | FOC | |
| | **Function** | Proportional coefficient **Kp** of current regulator **PI** Id and Iq in field rotary reference for motor n.1<br>(**P162** and **P169** relate to motors 2 and 3).<br>The regulator's structure is as follows:<br>error = *Set_Point – Measure;*<br>*integral_status* = *integral_status + error* ***Ki*Ts;**<br>*Output* = **Kp***error + integral_status;*<br>where Kp is the proportional coefficient<br>**Ki** is the integral coefficient = 1/Ti , where Ti is the integral time<br>**Ts** is the regulator operating time (ranging from 200 to 400 microseconds based on carrier frequency). | |

**NOTE** This parameter is **automatically computed and saved** with the Autotuning procedure..

## P156 (P163, P170) Current Regulator Integral Time

| | | | |
|---|---|---|---|
| **P156(motor n.1)<br>P163 (motor n.2)<br>P170 (motor n.3)** | **Range** | 1 ÷ 32000 | 1.0 ÷ 32000. (Disabled) |
| | **Default** | 200 | 20.0 ms |
| | **Level** | ENGINEERING | |
| | **Address** | 756<br>763 (motor n.2)<br>770 (motor n.3) | |
| | **Control** | FOC | |
| | **Function** | Integral time **Ti** of current regulator **PI** Id and Iq in the field rotary reference for motor n.1<br>(**P163** and **P170** relate to motors 2 and 3).<br>The regulator's structure is as follows:<br>error = *Set_Point – Measure;*<br>*integral_status* = *integral_status + error* ***Ki*Ts;**<br>*Output* = **Kp***error + integral_status;*<br>where Kp is the proportional coefficient<br>**Ki** is the integral coefficient = 1/Ti , where Ti is the integral time<br>**Ts** is the regulator operating time (ranging from 200 to 400 microseconds based on carrier frequency). | |

**NOTE** This parameter is **automatically computed and saved** with the Autotuning procedure. See AUTOTUNE MENU.

## P158 (P165, P172) Flux Regulator Proportional Constant

| P158(motor n.1)<br>P165 (motor n.2)<br>P172 (motor n.3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 65000 | 0.00 ÷ 650.00 |
| | Default | 300 | 3.00 |
| | Level | ENGINEERING | |
| | Address | 758<br>765 (motor n.2)<br>772 (motor n.3) | |
| | Control | FOC | |
| | Function | Proportional coefficient **Kp** of flux regulator **PI** for motor n.1<br>(**P165** and **P172** relate to motors 2 and 3).<br>The regulator's structure is as follows:<br>error = *Set_Point – Measure;*<br>*integral_status* = *integral_status* + *error* *Ki*Ts;*<br>*Output* = Kp**error* + *integral_status;*<br>where Kp is the proportional coefficient<br>**Ki** is the integral coefficient = 1/Ti , where Ti is the integral time<br>**Ts** is the regulator operating time (ranging from 200 to 400 microseconds based on carrier frequency). | |

## P159 (P166, P173) Flux Regulator Integral Time

| P159(motor n.1)<br>P166 (motor n.2)<br>P173 (motor n.3) | | | |
|---|---|---|---|
| | Range | 1 ÷ 32000 | 1.0 ÷ 32000. (Disabled) |
| | Default | 200 | 200 ms |
| | Level | ENGINEERING | |
| | Address | 759<br>766 (motor n.2)<br>773 (motor n.3) | |
| | Control | FOC | |
| | Function | Integral time **Ti** of flux regulator **PI** for motor n.1<br>(**P163** and **P170** relate to parameters 2 and 3).<br>The regulator's structure is as follows:<br>error = *Set_Point – Measure;*<br>*integral_status* = *integral_status* + *error* *Ki*Ts;*<br>*Output* = Kp**error* + *integral_status;*<br>where Kp is the proportional coefficient<br>**Ki** is the integral coefficient = 1/Ti , where Ti is the integral time<br>**Ts** is the regulator operating time (ranging from 200 to 400 microseconds based on carrier frequency). | |

NOTE

This parameter is automatically recomputed and saved whenever the Rotor Time Constant parameter (**C025**) is altered.

# 18. ANALOG AND FREQUENCY OUTPUTS MENU

## 18.1. Overview

NOTE

Please refer to the Sinus Penta **Installation Manual** for the hardware description of the analog output and the frequency output or for the configuration of the dip-switches for voltage/current outputs.

NOTE

By enabling the frequency output (**P200** other than Disabled) the digital output MDO1 is used. Any configuration set in the Digital Output menu will have no effect.

The Sinus Penta inverter allows for the configuration of three programmable analog outputs as voltage outputs or current outputs, as well as one frequency output.

### 18.1.1. FACTORY-SETTING OF THE ANALOG OUTPUTS

With the factory-setting the analog outputs have a voltage ranging from ± 10V and the following variables are selected:

| TERMINALS | OUTPUTS | VARIABLES SELECTED | CONVERSION CONSTANT |
|---|---|---|---|
| 10 | AO1 | Speed (motor speed) | 0.1 |
| 11 | AO2 | Speed Ref.(constant speed reference) | 0.1 |
| 12 | AO3 | Motor Current | 0.1 |

### 18.1.2. ANALOG OUTPUTS OVERVIEW

By means of the parameters of this menu it is possible to select the variable to be represented, its range, its acquisition mode ( +/- or as an absolute value), the type of analog output (voltage/current) and the output values corresponding to the min. value and the max. value of the selected variable. An offset value and a filter may also be applied to the analog outputs. For the frequency output, this menu contains the parameters for the selection of the represented variable, its acquisition mode (+/- or as an absolute value), its min. value and max. value and the corresponding output frequency value, and a filter. The figure below shows the general structure of the analog outputs; in particular the AO1analog output and its parameter set are illustrated.

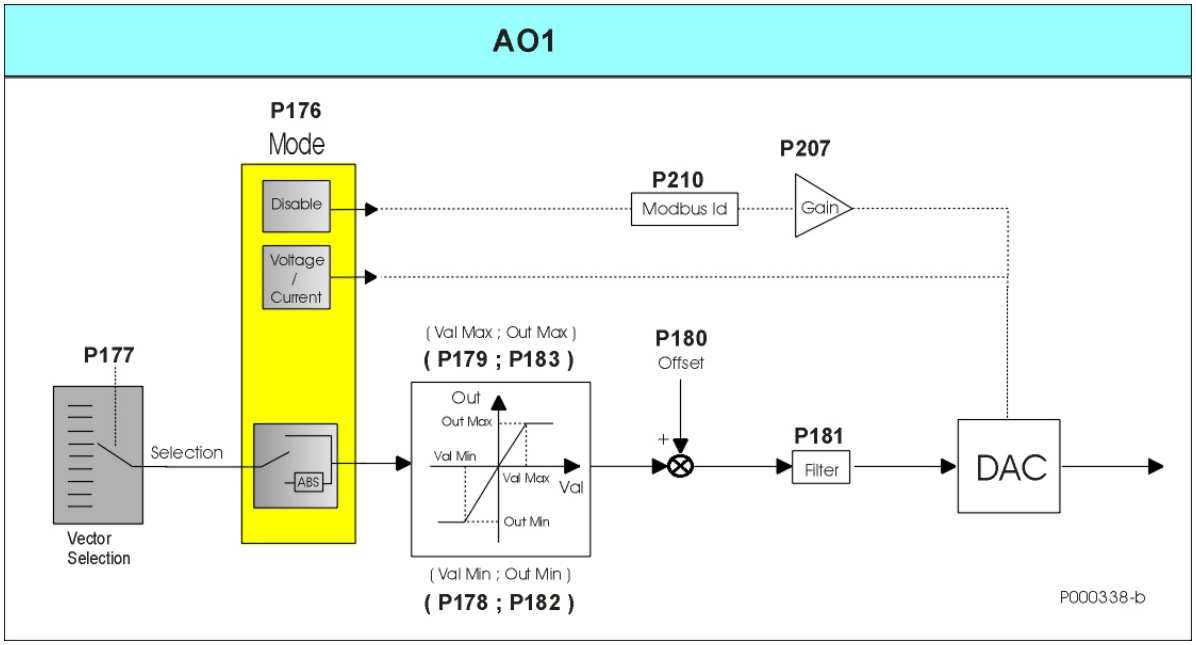



Figure 16: General structure of the Analog Outputs

- Vector Selection Selects the variable to be represented through the digital analog converter (DAC). **P177** is the selection parameter for the AO1analog output and **P185** and **P193** for AO2 and AO3 respectively.
- Mode Determines the acquisition mode of the selected variable (± or as an absolute value) and the type (voltage/current) for the analog output. If Mode = **Disable**, a different operating mode is activated for the analog output for which the represented variable is determined by the MODBUS address set in Address and the gain value set in Gain is applied:
  **P176** (Mode), **P207** (Gain), **P210** (Address) for AO1;
  **P184** (Mode), **P208** (Gain), **P211** (Address) for AO2;
  **P192** (Mode), **P209** (Gain), **P212** (Address) for AO3.

  - (Val Min; Out Min) Defines the minimum saturation value of the variable to be represented and the corresponding value to be assigned to the analog output. For values equal to or lower than Val Min, Out Min will be assigned to the selected analog output. For analog outputs AO1, AO2, and AO3, the following parameters will be used: **(P178; P182)**, **(P186; P194)** and **(P190; P198)** for values **(Val Min; Out Min).**

  - (Val Max; Out Max) Defines the maximum saturation value of the variable to be represented and the corresponding value to be assigned to the analog output. For values equal to or higher than Val Max, Out Max will be assigned to the selected analog output. For analog outputs AO1, AO2, and AO3, the following parameters will be used: **(P179; P183)**, **(P187; P195)** and **(P191; P199)** for values **(Val Max; Out Max).**

- Offset Defines the offset value applied to the analog output. Offset is set in parameter **P180** for analog output AO1, in parameters **P188**, **P196** for AO2 and AO3 respectively.
- Filter Defines the filter time constant applied to the analog output. The filter time constant is set in parameter **P181** for analog output AO1, in parameters **P189**, **P197** for AO2 and AO3 respectively.

### 18.1.3. OVERVIEW OF THE FREQUENCY OUTPUT

**When programming the frequency output, the setting of MDO1 in the Digital Outputs Menu is disabled.** The figure below illustrates the structure of the frequency output, the parameter description is similar to the analog outputs.

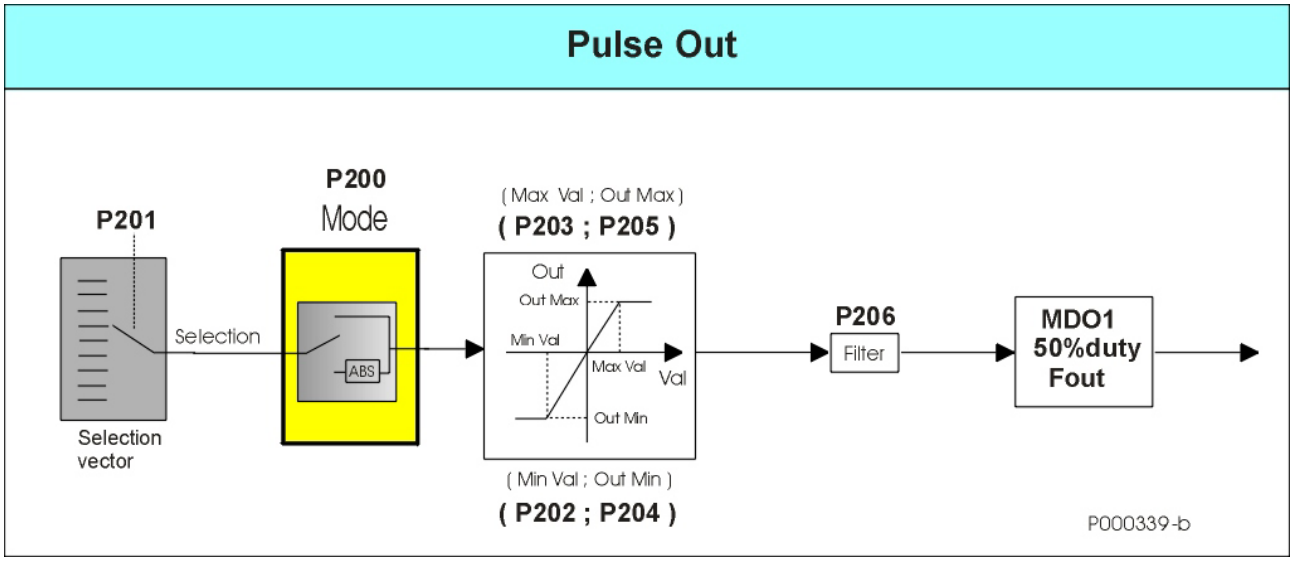



Figure 17: Structure of the Frequency Output

## 18.2. Variables

This section covers the variables that can be represented for the analog and frequency outputs.

**Table 19: Variables to be selected for the Analog and Frequency Outputs**

| SELECTION CODE | | |
|---|---|---|
| Selection Value | FS Ref. | Description |
| 0: Disable | 100.00% | Disabled output |
| 1: Motor Speed | 10000 rpm | Speed of the connected motor |
| 2: Speed Ref. | 10000 rpm | Speed reference at constant speed |
| 3: Ramp Out | 10000 rpm | "Ramped" speed reference |
| 4: Motor Frequency | 1000.0 Hz | Frequency produced by the inverter |
| 5: Motor Current | 1000.0 A | Current RMS |
| 6: Output Voltage | 1000.0 V | Output voltage RMS |
| 7: Output Power | 1000.0 kW | Output power |
| 8: V DC Bus | 1000.0 V | DC-link voltage |
| 9: Torque Reference | 100.00% | Torque reference at constant speed |
| 10: Torque Demand | 100.00% | Demanded torque |
| 11: Torque Output | 100.00% | Evaluation of the torque output |
| 12: Torque Limit | 100.00% | Setpoint of the torque limit |
| 13: PID Reference% | 100.00% | PID reference at constant speed |
| 14: PID Ramp % | 100.00% | "Ramped" PID reference |
| 15: PID Error% | 100.00% | Error between PID reference and feedback |
| 16: PID Feedback% | 100.00% | Feedback to the PID |
| 17: PID Output% | 100.00% | Output of the PID |
| 18: REF | 100.00% | Analog input REF |
| 19: AIN1 | 100.00% | Analog input AIN1 |
| 20: AIN2/Ptc | 100.00% | Analog input AIN2 |
| 21: Enc. In | 10000 rpm | Speed read by the encoder used as a reference |
| 22: PulseIn | 100.00 kHz | Frequency input |
| 23: Flux Ref | 1.0000 Wb | Flux reference at constant speed |
| 24: Flux | 1.0000 Wb | Current flux reference |
| 25: iq ref. | 1000.0 A | Current reference in axis q |
| 26: id ref. | 1000.0 A | Current reference in axis d |
| 27: iq | 1000.0 A | Current measure in axis q |
| 28: id | 1000.0 A | Current measure in axis d |
| 29: Volt.Vq | 1000.0 V | Voltage in axis q |
| 30: Volt Vd | 1000.0 V | Voltage in axis d |
| 31: Cosine | 100.00% | Cosine waveform |
| 32: Sine | 100.00% | Sine waveform |
| 33: Angle | 1.0000 rad | Electric angle of delivered Vu |
| 34: + 10V | 10.000 V | Voltage level +10V |
| 35: - 10V | 10.000 V | Voltage level –10V |
| 36: Flux Current | 1000.0 A | Flux Current |
| 37: Square Wave | 100.00% | Square wave |
| 38: Saw Wave | 100.00% | Saw wave |
| 39: Heatsink Temp. | 100.00 °C | Temperature of the heatsink |
| 40: Ambient Temp. | 100.00 °C | Ambient temperature |

Table 19 provides a brief description of each variable and its full-scale value (FE Ref.).

### 18.2.1. OPERATING MODE OF ANALOG AND FREQUENCY OUTPUTS

This section covers the different representation modes to be selected for the analog and frequency outputs.

The following modes can be used for analog outputs:

| | |
|---|---|
| 0: Disable | Disabled analog output. Enables an operating mode of the analog output which can be accessed only by the Elettronica Santerno staff. |
| 1: ± 10V | The analog output is set as a voltage output and the possible min. and max. output values range from +/ – 10V. The selected variable has a positive or negative sign. |
| 2: 0÷10V | The analog output is set as a voltage output and the possible min. and max. output values range from 0 ÷ 10V. The selected variable has a positive or negative sign. |
| 3: 0÷20mA | The analog output is set as a current output and the possible min. and max. output values range from 0 ÷ 20mA. The selected variable has a positive or negative sign. |
| 4: 4÷20mA | The analog output is set as a current output and the possible min. and max. output values range from 4 ÷ 20mA. The selected variable has a positive or negative sign. |
| 5: ABS 0÷10V | Like the output mode 0 ÷ 10V except that the selected variable is considered as an absolute value. |
| 6:ABS 0÷20mA | Like the output mode 0 ÷ 20mA except that the selected variable is considered as an absolute value. |
| 7:ABS 4÷20mA | Like the output mode 4 ÷ 20mA except that the selected variable is considered as an absolute value. |

NOTE Always check the min. and max. values of the outputs programmed in the relative parameters.

For the Frequency Output three operating modes can be selected:

| | |
|---|---|
| 0: Disable | The output frequency is disabled. |
| 1: Pulse Out | The Digital output MDO1 is programmed as a frequency output. The selected variable has a positive or negative sign. |
| 2: ABS Pulse Out | Like the Pulse Out except that the selected variable has a positive or negative sign. |

NOTE When **P200** is not set to DISABLE, the MDO1digital output is used as a frequency output and any eventual MD01 settings in the Digital Outputs Menu are ignored.

### 18.2.2. ANALOG OUTPUT PROGRAMMING EXAMPLES

This section contains a description of operating examples of the analog outputs obtained with different programming modes.

**Example 1:**

Table 20: Programming AO1 (0 ÷ 10V)

| Parameterisation of Analog Output AO1 | | |
|---|---|---|
| Parameter | Value | Description |
| P176 | 0÷10V | Analog output AO1 |
| P177 | 1: Speed | Selected variable analog output AO1 |
| P178 | –500 rpm | Min. value of the selected variable AO1 |
| P179 | +500 rpm | Max. value of the selected variable AO1 |
| P180 | 0.000 V | Analog output offset AO1 |
| P181 | 0 ms | Filter on analog output AO1 |
| P182 | 0.0 V | Min. output value AO1 with reference to P178 |
| P183 | 10.0 V | Min. output value AO1 with reference to P179 |

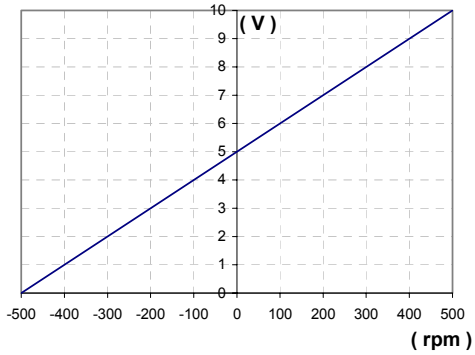



Figure 18: Curve (voltage; speed) carried out by AO1 (Example 1)

**Example 2:**

Table 21: Programming AO1 (ABS 0 ÷ 10V)

| Parameterisation of Analog Output AO1 | | |
|---|---|---|
| Parameter | Value | Description |
| P176 | ABS 0÷10V | Analog output AO1 |
| P177 | 1: Speed | Selected variable analog output AO1 |
| P178 | 0 rpm | Min. value of the selected variable AO1 |
| P179 | +500 rpm | Max. value of the selected variable AO1 |
| P180 | 0.000 V | Analog output offset AO1 |
| P181 | 0 ms | Filter on analog output AO1 |
| P182 | 0.0 V | Min. output value AO1 with reference to P178 |
| P183 | 10.0 V | Min. output value AO1 with reference to P179 |

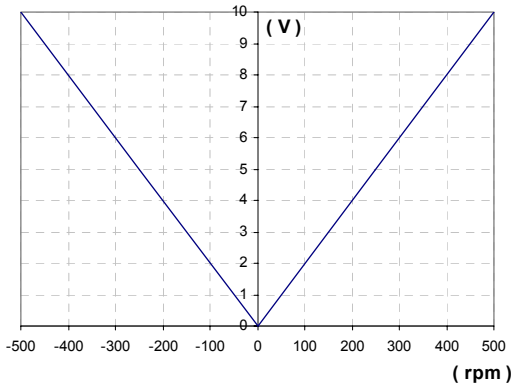



Figure 19: Curve (voltage; speed) carried out by AO1 (Example 2)

Example 3:

Table 22: Programming AO1 (ABS 0 ÷ 10V)

| Parameterisation of Analog Output AO1 | | |
|---|---|---|
| **Parameter** | **Value** | **Description** |
| P176 | ABS 0÷10V | Analog output AO1 |
| P177 | 1: Speed | Selected variable analog output AO1 |
| P178 | –500 rpm | Min. value of the selected variable AO1 |
| P179 | +500 rpm | Max. value of the selected variable AO1 |
| P180 | 0.000 V | Analog output offset AO1 |
| P181 | 0 ms | Filter on analog output AO1 |
| P182 | 0.0 V | Min. output value AO1 with reference to P178 |
| P183 | 10.0 V | Min. output value AO1 with reference to P179 |

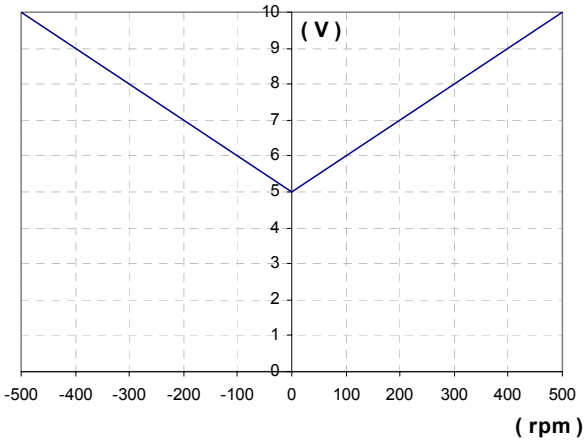



Figure 20: Curve (voltage; speed) carried out by AO1 (Example 3)

**NOTE**

This programming implies a straight line passing through (–500rpm; 0V) and (+500rpm; 10V), but based on the selected mode, considering the variable as an absolute value, the min. point for output AO1 will be (0 rpm; 5 V).

Example 4:

Table 23: Programming AO1 (ABS 0 ÷ 10V)

| Parameterisation of Analog Output AO1 | | |
|---|---|---|
| **Parameter** | **Value** | **Description** |
| P176 | ABS 0÷10V | Analog output AO1 |
| P177 | 1: Speed | Selected variable analog output AO1 |
| P178 | +100 rpm | Min. value of the selected variable AO1 |
| P179 | +500 rpm | Max. value of the selected variable AO1 |
| P180 | 0.000 V | Analog output offset AO1 |
| P181 | 0 ms | Filter on analog output AO1 |
| P182 | 0.0 V | Min. output value AO1 with reference to P178 |
| P183 | 10.0 V | Min. output value AO1 with reference to P179 |

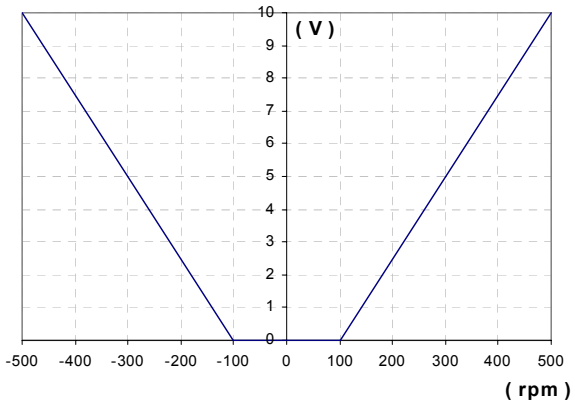



Figure 21: Curve (voltage; speed) carried out by AO1 (Example 4)

Example 5:

Table 24: Programming AO1 (± 10V)

| Parameterisation of Analog Output AO1 | | |
|---|---|---|
| **Parameter** | **Value** | **Description** |
| P176 | ±10V | Analog output AO1 |
| P177 | 1: Speed | Selected variable analog output AO1 |
| P178 | +500 rpm | Min. value of the selected variable AO1 |
| P179 | –500 rpm | Max. value of the selected variable AO1 |
| P180 | 0.000 V | Analog output offset AO1 |
| P181 | 0 ms | Filter on analog output AO1 |
| P182 | –10.0 V | Min. output value AO1 with reference to P178 |
| P183 | +10.0 V | Min. output value AO1 with reference to P179 |

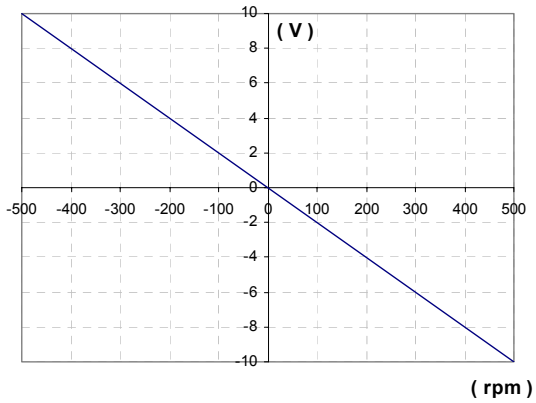



Figure 22: Curve (voltage; speed) carried out by AO1 (Example 5)

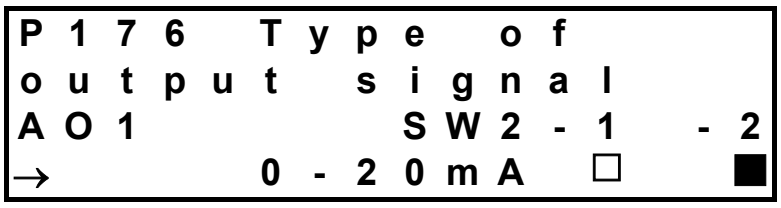
## 18.3. List of Parameters from P176 to P215

Table 25: List of Parameters P176 ÷ P215

| Param. | Function | Access Level | ModBus Address | Default Value |
|---|---|---|---|---|
| P176 | AO1 analog output | ADVANCED | 776 | 1: +/- 10V |
| P177 | AO1 analog output Variable selection | ADVANCED | 777 | Motor speed |
| P178 | AO1 Min. value of selected variable | ADVANCED | 778 | -15.00% of 10000 rpm = -1500 rpm |
| P179 | AO1 Max. value of selected variable | ADVANCED | 779 | +15.00% of 10000 rpm = +1500 rpm |
| P180 | AO1Off–set on analog output | ADVANCED | 780 | 0.000 V |
| P181 | AO1 filter on analog output | ADVANCED | 781 | 0 ms |
| P182 | AO1 Output min. value with reference to **P178** | ADVANCED | 782 | -10.0 V |
| P183 | AO1 Output max. value with reference to **P179** | ADVANCED | 783 | +10.0V |
| P184 | AO2 analog output | ADVANCED | 784 | 1: +/- 10V |
| P185 | AO2 analog output Variable selection | ADVANCED | 785 | Constant speed reference |
| P186 | AO2 Min. value of selected variable | ADVANCED | 786 | -1500 rpm |
| P187 | AO2 Max. value of selected variable | ADVANCED | 787 | +1500 rpm |
| P188 | AO2Offset on analog output | ADVANCED | 788 | 0.000 V |
| P189 | AO2 filter on analog output | ADVANCED | 789 | 0 ms |
| P190 | AO2 Output min. value with reference to **P186** | ADVANCED | 790 | -10.0 V |
| P191 | AO2 Output max. value with reference to **P187** | ADVANCED | 791 | +10.0V |
| P192 | AO3 analog output | ADVANCED | 792 | 1: +/- 10V |
| P193 | AO3 analog output Variable selection | ADVANCED | 793 | Output current |
| P194 | AO3 Min. value of selected variable | ADVANCED | 794 | 0 A |
| P195 | AO3 Max. value of selected variable | ADVANCED | 795 | Imax inverter |
| P196 | AO3 Offset on analog output | ADVANCED | 796 | 0.000 V |
| P197 | AO3 filter on analog output | ADVANCED | 797 | 0 ms |
| P198 | AO3 Output min. value with reference to **P194** | ADVANCED | 798 | -10.0 V |
| P199 | AO3 Output max. value with reference to **P195** | ADVANCED | 799 | +10.0V |
| P200 | FOUT output in [MDO1] frequency | ADVANCED | 800 | 0: Disabled |
| P201 | FOUT output frequency variable selection | ADVANCED | 801 | Speed |
| P202 | FOUT Min. value of selected value | ADVANCED | 802 | 0 |
| P203 | FOUT Max. value of selected value | ADVANCED | 803 | 0 |
| P204 | FOUT Output Min. value with reference to **P202** | ADVANCED | 804 | 10.00 kHz |
| P205 | FOUT Output Max. value with reference to **P203** | ADVANCED | 805 | 100.00 kHz |
| P206 | Filter on FOUT frequency output | ADVANCED | 806 | 0 ms |
| P207 | AO1: Gain | ADVANCED | 807 | reserved |
| P208 | AO2: Gain | ADVANCED | 808 | reserved |
| P209 | AO3: Gain | ADVANCED | 809 | reserved |
| P210 | AO1: MODBUS Variable address | ADVANCED | 810 | reserved |
| P211 | AO2: MODBUS Variable address | ADVANCED | 811 | reserved |
| P212 | AO3: MODBUS Variable address | ADVANCED | 812 | reserved |
| P213 | Amplitude of sinusoidal analog output signal | ENGINEERING | 813 | 100.0% |
| P214 | Frequency of sinusoidal analog output signal | ENGINEERING | 814 | 1.00 Hz |
| P215 | Frequency of triangular analog output signal | ENGINEERING | 815 | 1.00 Hz |

P176 AO1Analog output

| | | | |
|---|---|---|---|
| P176 | Range | 0 ÷ 7 | 0: Disabled,<br>1: ± 10V,<br>2: 0 ÷ 10V,<br>3: 0 ÷ 20mA,<br>4: 4 ÷ 20mA,<br>5: ABS 0 ÷ 10V,<br>6: ABS 0 ÷ 20mA,<br>7: ABS 4 ÷ 20mA. |
| | Default | 1 | 1: ± 10V |
| | Level | ADVANCED | |
| | Address | 776 | |
| | Function | Selects the operating mode of AO1analog output. | |




The example shows the A01 analog output current setting and the relative Dip-switch SW2 position is indicated with the contact 1 open and contact 2 closed.

NOTE

Analog outputs are set as voltage outputs by default; to switch to the current outputs see the DIP-switches configuration and follow the instructions on the keypad or consult the Installation Manual.

P177 AO1 analog output Variable selection

| | | | |
|---|---|---|---|
| P177 | Range | 0 ÷ 40 | See Table 19 |
| | Default | 1 | Motor speed |
| | Level | ADVANCED | |
| | Address | 777 | |
| | Function | Selects the variable to be represented on the AO1 output. | |

P178 AO1 Min. value of selected variable

| | | | |
|---|---|---|---|
| P178 | Range | Function according to selection of **P177** | See Table 19 |
| | Default | –1500 | –15.00% di 10000 rpm = –1500 rpm |
| | Level | ADVANCED | |
| | Address | 778 | |
| | Function | Minimum value of the motor speed corresponding to the AO1 Output min. value with reference to **P182.** | |

P179 AO1 Max. value of selected variable

| P179 | Range | Function according to selection of **P177** | See Table 19 |
|---|---|---|---|
| | Default | +1500 | +15.00% di 10000 rpm = +1500 rpm |
| | Level | ADVANCED | |
| | Address | 779 | |
| | Function | Maximum value of the motor speed corresponding to the AO1 Output min. value with reference to **P183**. | |

P180 AO1Offset on analog output

| P180 | Range | Function according to selection of **P176** | –9.999 ÷ +9.999 |
|---|---|---|---|
| | Default | 0 | 0.000 V |
| | Level | ADVANCED | |
| | Address | 780 | |
| | Function | Offset value applied to the AO1 analog output. | |

P181 AO1 filter on analog output

| P181 | Range | 0 ÷ 65000 | 0.000 ÷ 65.000 sec. |
|---|---|---|---|
| | Default | 0 | 0.000 sec. |
| | Level | ADVANCED | |
| | Address | 781 | |
| | Function | Time constant value of the filter applied to the AO1 analog output. | |

P182 AO1 Output min. value with reference to P178

| P182 | Range | Function according to selection of **P176** | –10.0 ÷ +10.0 V<br>–20.0 ÷ +20.0 mA |
|---|---|---|---|
| | Default | –100 | –10.0 V |
| | Level | ADVANCED | |
| | Address | 782 | |
| | Function | Minimum output value obtained in correspondence with the minimum value of the variable **P178**. | |

P183 AO1 Output max. value with reference to P179

| P183 | Range | Function according to selection of **P176** | –10.0 ÷ +10.0 V<br>–20.0 ÷ +20.0 mA |
|---|---|---|---|
| | Default | +100 | +10.0 V |
| | Level | ADVANCED | |
| | Address | 783 | |
| | Function | Maximum output value obtained in correspondence with the maximum value of the variable **P179**. | |

P184 AO2 analog output

| | | | |
|---|---|---|---|
| P184 | Range | 0 ÷ 7 | 0: Disabled,<br>1: ± 10V,<br>2: 0 ÷ 10V,<br>3: 0 ÷ 20mA,<br>4: 4 ÷ 20mA,<br>5: ABS 0 ÷ 10V,<br>6: ABS 0 ÷ 20mA,<br>7: ABS 4 ÷ 20mA. |
| | Default | 1 | 1: ± 10V |
| | Level | ADVANCED | |
| | Address | 784 | |
| | Function | Selects the operating mode of the AO2 analog output. | |

NOTE

Analog outputs are set as voltage outputs by default; to switch to the current outputs see the DIP-switches configuration and follow the instructions on the keypad or consult the Installation Manual.

P185 AO2 analog output Variable selection

| | | | |
|---|---|---|---|
| P185 | Range | 0 ÷ 40 | See Table 19 |
| | Default | 2 | Constant speed reference |
| | Level | ADVANCED | |
| | Address | 785 | |
| | Function | Selects the variable to be represented on the AO2 output. | |

P186 AO2 Min. value of selected variable

| | | | |
|---|---|---|---|
| P186 | Range | Function according to selection of **P185** | See Table 19 |
| | Default | –1500 | –1500 rpm |
| | Level | ADVANCED | |
| | Address | 786 | |
| | Function | Minimum motor speed value obtained in correspondence with the minimum AO2 value of the variable **P190**. | |

P187 AO2 Max. value of selected variable

| | | | |
|---|---|---|---|
| P187 | Range | Function according to selection of **P185** | See Table 19 |
| | Default | +1500 | +1500 rpm |
| | Level | ADVANCED | |
| | Address | 787 | |
| | Function | Maximum motor speed value obtained in correspondence with the minimum AO2 value of the variable **P191**. | |

P188 AO2Offset on analog output

| P188 | Range | Function according to selection of **P184** | See Table 19 |
|---|---|---|---|
| | Default | 0 | 0.000 V |
| | Level | ADVANCED | |
| | Address | 788 | |
| | Function | AO2 Offset value applied to the AO2 analog output. | |

P189 AO2 filter on analog output

| P189 | Range | 0 ÷ 65000 | 0.000÷65.000 sec. |
|---|---|---|---|
| | Default | 0 | 0.000 sec. |
| | Level | ADVANCED | |
| | Address | 789 | |
| | Function | Time constant value of the filter applied to the AO2 analog output. | |

P190 AO2 Output min. value with reference to P186

| P190 | Range | Function according to selection of **P184** | See Table 19 |
|---|---|---|---|
| | Default | –100 | –10.0 V |
| | Level | ADVANCED | |
| | Address | 790 | |
| | Function | Minimum output value obtained in correspondence with the minimum value of the variable **P186**. | |

P191 AO2 Output max. value with reference to P187

| P191 | Range | Function according to selection of **P184** | See Table 19 |
|---|---|---|---|
| | Default | +100 | +10,0 V |
| | Level | ADVANCED | |
| | Address | 791 | |
| | Function | Maximum output value obtained in correspondence with the maximum value of the variable **P187**. | |

P192 AO3 analog output

| P192 | Range | 0 ÷ 7 | 0: Disabled,<br>1: ± 10V,<br>2: 0 ÷ 10V,<br>3: 0 ÷ 20mA,<br>4: 4 ÷ 20mA,<br>5: ABS 0 ÷ 10V,<br>6: ABS 0 ÷ 20mA,<br>7: ABS 4 ÷ 20mA. |
|---|---|---|---|
| | Default | 1 | 1: ± 10V |
| | Level | ADVANCED | |
| | Address | 792 | |
| | Function | Selects the operating mode of the AO3 analog output. | |

**NOTE**

Analog outputs are set as voltage outputs by default; to switch to the current outputs see the dip-switch configuration and follow the instructions on the keypad or consult the Installation Manual.

**P193 AO3 analog output Variable selection**

| P193 | Range | 0 ÷ 40 | See Table 19 |
|---|---|---|---|
| | Default | 5 | 5: Motor current |
| | Level | ADVANCED | |
| | Address | 793 | |
| | Function | Selects the variable to be represented on the AO3 output. | |

**P194 AO3 Min. value of selected variable**

| P194 | Range | Function according to selection of **P193** | See Table 19 |
|---|---|---|---|
| | Default | 0 | 0 A |
| | Level | ADVANCED | |
| | Address | 794 | |
| | Function | Minimum motor current value obtained in correspondence with the minimum AO3 value of the variable **P198**. | |

**P195 AO3 Max. value of selected variable**

| P195 | Range | Function according to selection of **P193** | See Table 19 |
|---|---|---|---|
| | Default | Imax Inverter | Inverter maximum current function of size |
| | Level | ADVANCED | |
| | Address | 795 | |
| | Function | Maximum motor speed value obtained in correspondence with the minimum AO3 value of the variable **P199**. | |

**P196 AO3 Offset on analog output**

| P196 | Range | Function according to selection of **P192** | See Table 19 |
|---|---|---|---|
| | Default | 0 | 0.000 V |
| | Level | ADVANCED | |
| | Address | 796 | |
| | Function | Offset value applied to the AO3 analog output. | |

**P197 AO3 filter on analog output**

| P197 | Range | 0 ÷ 65000 sec. | 0,000 ÷ 65.000 sec. |
|---|---|---|---|
| | Default | 0 | 0.000 sec. |
| | Level | ADVANCED | |
| | Address | 797 | |
| | Function | Time constant value of the filter applied to the AO3 analog output. | |

P198 AO3 Output min. value with reference to P194

| P198 | Range | Function according to selection of **P192** | See Table 19 |
|---|---|---|---|
| | Default | –100 | –10.0 V |
| | Level | ADVANCED | |
| | Address | 798 | |
| | Function | Minimum output value obtained in correspondence with the maximum value of the variable **P194**. | |

P199 AO3 Output max. value with reference to P195

| P199 | Range | Function according to selection of **P192** | See Table 19 |
|---|---|---|---|
| | Default | +100 | +10.0 V |
| | Level | ADVANCED | |
| | Address | 799 | |
| | Function | Maximum output value obtained in correspondence with the maximum value of the variable **P195**. | |

P200 FOUT output in [MDO1] frequency

| P200 | Range | 0 ÷ 2 | 0: Disabled,<br>1: Pulse,<br>2: ABS Pulse . |
|---|---|---|---|
| | Default | 0 | 0: Disabled |
| | Level | ADVANCED | |
| | Address | 800 | |
| | Function | Selects the operating mode of the FOUT frequency output. | |

NOTE

When not set to DISABLE, the MDO1 digital output is used as a frequency output and any eventual MD01 settings in the Digital Outputs Menu are ignored.

P201 FOUT frequency output variable selection

| P201 | Range | 0 ÷ 40 | See Table 19 |
|---|---|---|---|
| | Default | 0 | No selection |
| | Level | ADVANCED | |
| | Address | 801 | |
| | Function | Selects the variable to represent on the FOUT frequency . | |

P202 FOUT Min. value of selected value

| P202 | Range | Function according to selection of **P201** | See Table 19 |
|---|---|---|---|
| | Default | 0 | 0 |
| | Level | ADVANCED | |
| | Address | 802 | |
| | Function | Minimum value of the selected variable. | |

P203 FOUT Max. value of selected value

| P203 | Range | Function according to selection of **P201** | See Table 19 |
|---|---|---|---|
| | Default | 0 | 0 |
| | Level | ADVANCED | |
| | Address | 803 | |
| | Function | Maximum value of the selected variable. | |

P204 FOUT Output Min. value with reference to P202

| P204 | Range | 1000÷10000 | 10.00÷100.00 kHz |
|---|---|---|---|
| | Default | 1000 | 10.00 kHz |
| | Level | ADVANCED | |
| | Address | 804 | |
| | Function | Minimum output value obtained in correspondence with the minimum value of the variable **P202.** | |

P205 FOUT Output Max. value with reference to P203

| P205 | Range | 1000÷10000 | 10.00÷100.00 kHz |
|---|---|---|---|
| | Default | 10000 | 100.00 kHz |
| | Level | ADVANCED | |
| | Address | 805 | |
| | Function | Maximum output value obtained in correspondence with the maximum value of the variable **P203**. | |

P206 Filter on FOUT frequency output

| P206 | Range | 0 ÷ 65000 | 0.000 ÷ 65.000 sec |
|---|---|---|---|
| | Default | 0 | 0.000 sec. |
| | Level | ADVANCED | |
| | Address | 806 | |
| | Function | Time constant value of the filter applied to the FOUT frequency output. | |

| | |
|---|---|
| P207 AO1: Gain<br>P208 AO2: Gain<br>P209 AO3: Gain<br>P210 AO1: MODBUS Address Variable<br>P211 AO2: MODBUS Address Variable<br>P212 AO3: MODBUS Address Variable | Reserved |

P213 Amplitude of sinusoidal analog output signal

| P213 | Range | 0 ÷ 1000 | 0 ÷ 100.0% |
|---|---|---|---|
| | Default | 1000 | 100.0% |
| | Level | ENGINEERING | |
| | Address | 813 | |
| | Function | Amplitude of the sinusoidal analog output signal when Sine or Cosine variables are selected. | |

P214 Frequency of sinusoidal analog output signal

| P214 | | | |
|---|---|---|---|
| | Range | 0 ÷ 20000 | 0 ÷ 200.00Hz |
| | Default | 100 | 1.00Hz |
| | Level | ENGINEERING | |
| | Address | 814 | |
| | Function | Frequency of the sinusoidal analog output signal when Sine or Cosine variables are selected. | |

P215 Frequency of triangular analog output signal

| P215 | | | |
|---|---|---|---|
| | Range | 0 ÷ 20000 | 0 ÷ 200.00Hz |
| | Default | 100 | 1.00Hz |
| | Level | ENGINEERING | |
| | Address | 815 | |
| | Function | Frequency of triangular analog output signal when Sine or Cosine variables are selected, which can be used as carrier frequency if MDO1 or MDO2 is to be selected with PWM mode. See example in the Digital Outputs Menu. | |

# 19. TIMERS MENU

## 19.1. Overview

In the Timers menu, it is possible to set enabling and disabling delay times for digital inputs/outputs.

5

**NOTE** For **ENABLE** digital input, no disabling delay is allowed, because the logic status of the **ENABLE** command is used directly by the hardware activating IGBT commutation; when no **ENABLE** command is sent, the output power stage is instantly deactivated.

**NOTE** The reset function for the alarms on the leading edges of the MDI3 is not delayed.

**NOTE** Any auxiliary alarm set to the digital inputs is not delayed.

**NOTE** Five timers are available and for each timer it is possible to set an enabling/disabling delay. The same timer may also be assigned to multiple digital inputs/outputs.

**NOTE** The **ENABLE –S** function cannot be delayed.

*Example 1:*

The inverter enabling (**MDI1 START**) depends on a signal coming from a different equipment source and there is the need to delay the inverter enabling by 2 seconds with respect to activation, and by 5 seconds with respect to deactivation. To do so, set two delay times for activation and deactivation to the same timer and assign it to **START** digital input **MDI1**. In the example below, timer 1 is used.

**P216** 2.0 sec Activation delay T1
**P217** 5.0 sec Deactivation delay T1
**P226** 0x0001 Timer assigned to **MDI1** (**START**)

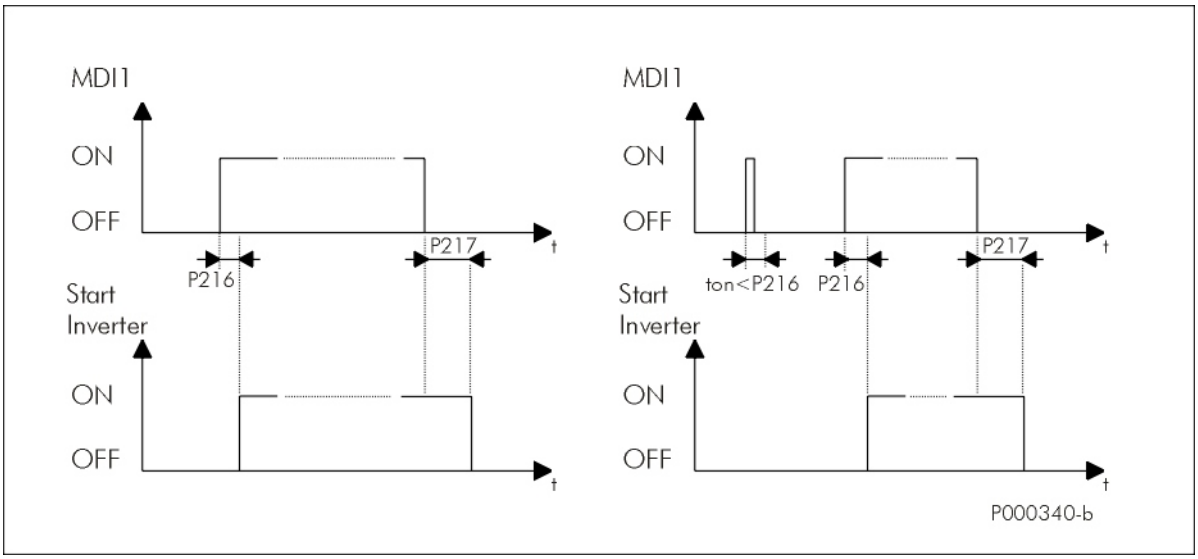



**Figure 23: Using Timers (Example)**

Figure shows two possible operating modes:
- on the left: application of the delay times set for the inverter enabling/disabling;
- on the right: the start signal persists for a shorter time than the delay set for enabling; in this case, the Start function is not enabled. The Start function will be enabled only when digital input **MDI1** is ON for a time longer than the time set in **P216**.

## 19.2. List of Parameters from P216 to P228

Table 26: List of Parameters P216 ÷ P228

| Parameter | FUNCTION | Access Level | Default Values | MODBUS Address |
|---|---|---|---|---|
| P216 | T1 Enabling delay | ENGINEERING | 0.0 | 816 |
| P217 | T1 Disabling delay | ENGINEERING | 0.0 | 817 |
| P218 | T2 Enabling delay | ENGINEERING | 0.0 | 818 |
| P219 | T2 Disabling delay | ENGINEERING | 0.0 | 819 |
| P220 | T3 Enabling delay | ENGINEERING | 0.0 | 820 |
| P221 | T3 Disabling delay | ENGINEERING | 0.0 | 821 |
| P222 | T4 Enabling delay | ENGINEERING | 0.0 | 822 |
| P223 | T4 Disabling delay | ENGINEERING | 0.0 | 823 |
| P224 | T5 Enabling delay | ENGINEERING | 0.0 | 824 |
| P225 | T5 Disabling delay | ENGINEERING | 0.0 | 825 |
| P226 | Timer assigned to inputs MDI1÷4 | ENGINEERING | No timer assigned to the inputs MDI 1; 4 | 826 |
| P227 | Timer assigned to inputs MDI5÷4 | ENGINEERING | No timer assigned to the Inputs MDI 5; 8 | 827 |
| P228 | Timer assigned to outputs MDO1÷4 | ENGINEERING | No timer assigned to the outputs MDO 1; 4 | 828 |

P216 T1 Enabling delay

| P216 | | | |
|---|---|---|---|
| | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 816 | |
| | Function | This parameter determines T1 enabling time.<br>With **P226** or **P227**, if **timer T1** is assigned to a digital input having a particular function, this parameter represents the delay occurring between the input closing and the function activation.<br>Use **P228** to assign timer 1 to a digital output; in this case, the digital input energizing will be delayed according to the time set in **P216**. | |

P217 T1 Disabling delay

| P217 | | | |
|---|---|---|---|
| | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 817 | |
| | Function | This parameter determines T1 disabling time.<br>With **P226** or **P227**, if **timer T1** is assigned to a digital input having a particular function, this parameter represents the delay occurring between the input closing and the function deactivation.<br>Use **P228** to assign timer 1 to a digital output; in that case, the digital input de-energizing will be delayed according to the time set in **P217.** | |

P218 T2 Enabling delay

| P218 | | | |
|---|---|---|---|
| | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 818 | |
| | Function | This parameter determines T2 enabling time.<br>(Operation as per **P216**.) | |

P219 T2 Disabling delay

| P219 | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
|---|---|---|---|
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 819 | |
| | Function | This parameter determines T2 disabling time.<br>(Operation as per **P217**). | |

P220 T3 Enabling delay

| P220 | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
|---|---|---|---|
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 820 | |
| | Function | This parameter determines T3 enabling time.<br>(Operation as per **P216**.) | |

P221 T3 Disabling delay

| P221 | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
|---|---|---|---|
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 821 | |
| | Function | This parameter determines T3 disabling time.<br>(Operation as per **P217**.) | |

P222 T4 Enabling delay

| P222 | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
|---|---|---|---|
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 822 | |
| | Function | This parameter determines T4 enabling time.<br>(Operation as per **P216**.) | |

P223 T4 Disabling delay

| P223 | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
|---|---|---|---|
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 823 | |
| | Function | This parameter determines T4 disabling time.<br>(Operation as per **P217**.) | |

P224 T5 Enabling delay

| P224 | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
|---|---|---|---|
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 824 | |
| | Function | This parameter determines T5 enabling time.<br>(Operation as per **P216**.) | |

P225 T5 Disabling delay

| P225 | | | |
|---|---|---|---|
| | Range | 0 ÷ 60000 | 0.0 ÷ 6000.0 sec |
| | Default | 0 | 0.0 |
| | Level | ENGINEERING | |
| | Address | 825 | |
| | Function | This parameter determines T5 disabling time.<br>(Operation as per **P217**.) | |

P226 Timer assigned to inputs MDI 1÷4

| P226 | | | |
|---|---|---|---|
| | Range | [ 0; 0; 0; 0 ] ÷ [ 5; 5; 5; 5 ] | |
| | Default | [ 0; 0; 0; 0 ] | No timer assigned to the inputs MDI 1 ÷ 4 |
| | Level | ENGINEERING | |
| | Address | 826 | |
| | Function | The first group of four digital inputs may be assigned to any of the five timers and the same timer may be assigned to multiple inputs.<br>Select "zero" to avoid delaying the digital inputs.<br>For setting via serial link: see encoding below. | |

Table 27: Codification of P226: Timers assigned to Digital Inputs (Example)

| Input | Timer | Bit Set | Binary | Decimal |
|---|---|---|---|---|
| MDI1 | 2 | BIT0–BIT2 | 010 | 2 |
| MDI2 | 5 | BIT3–BIT5 | 101 | 5 |
| MDI3 | 3 | BIT6–BIT8 | 011 | 3 |
| MDI4 | 5 | BIT9–BIT11 | 101 | 5 |
| Value in **P226** 101 011 101 010bin → 2794dec | | | | |

P227 Timer assigned to inputs MDI 5÷8

| P227 | | | |
|---|---|---|---|
| | Range | [ 0; 0; 0; 0 ] ÷ [ 5; 5; 5; 5 ] | |
| | Default | [ 0; 0; 0; 0 ] | No timer assigned to the inputs MDI 5 ÷ 8 |
| | Level | ENGINEERING | |
| | Address | 827 | |
| | Function | The second group of four digital inputs may be assigned to any of the five timers and the same timer may be assigned to multiple inputs.<br>Select "zero" to avoid delaying the digital inputs.<br>For setting via serial link: see encoding in **P226**. | |

P228 Timer assigned to outputs MDO 1÷4

| P228 | | | |
|---|---|---|---|
| | Range | [ 0; 0; 0; 0 ] ÷ [ 5; 5; 5; 5 ] | |
| | Default | [ 0; 0; 0; 0 ] | No timer assigned to the outputs MDO 1 ÷ 4 |
| | Level | ENGINEERING | |
| | Address | 828 | |
| | Function | The digital outputs may be assigned to any of the five timers and the same timer may be assigned to multiple outputs.<br>Select "zero" to avoid delaying the digital outputs.<br>For setting via serial link: see encoding in **P226**. | |

# 20. PID PARAMETERS MENU

## 20.1. Overview

This menu defines the parameters for the digital PID regulator integrated in the inverter.
The PID regulator may be used to control a physical variable external to the inverter; the variable measure shall be available in the system and must be connected to the "feedback" input.
The PID regulator is used to keep the reference and the control variable constant (feedback); to do so, the PID regulator controls three internal variables, which are described below:

- ✓ Proportional term: this the variable detecting the instant difference between the reference and the measured value of the physical variable to be controlled ( "error ");
- ✓ Integral term: this is the variable keeping track of the "history" of the detected errors (summation of all errors);
- ✓ Derivative term: this is the variable keeping track of the evolution of the error or the controlled variable (difference between two consecutive errors or between two consecutive values of the feedbacked variable);

The weighed summation of these terms represents the output signal of PID regulator.
The weight of these three terms may be defined by the user with the parameters below.

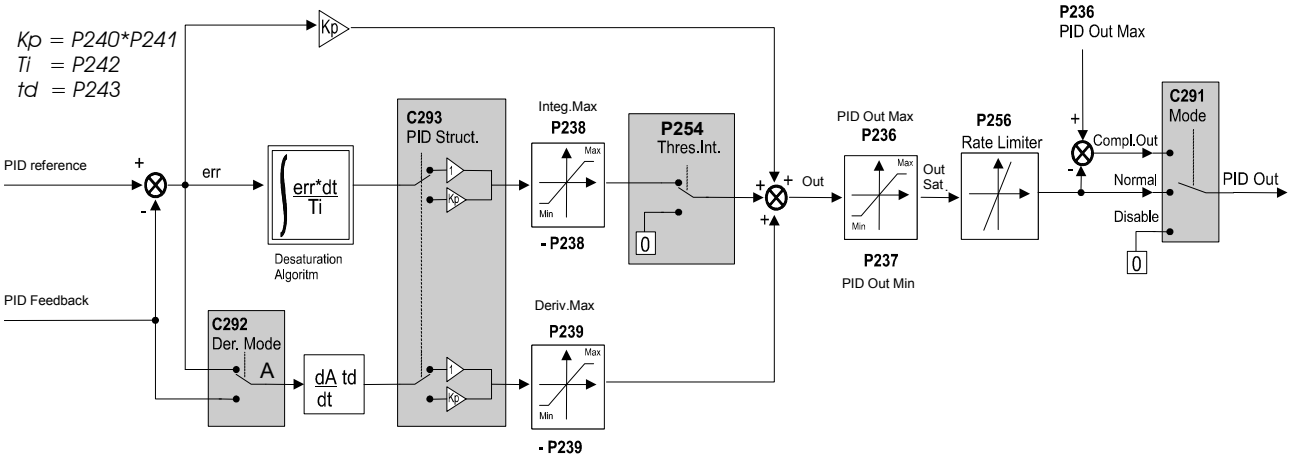



Figure 24: PID Block Diagram

NOTE

In Local mode, the PID regulator is disabled if it is used as a correction of the reference or of voltage (**C294 = 2: Sum Reference** or **C294 =3: Sum Voltage**).

NOTE

In **LOCAL mode,** if the inverter reference is the PID output **C294=Reference** the Type parameter of the Keypad page in Local is **P266=Rif.Active+Vel**; by activating the local mode in the Keypad page it is possible to alter the PID reference. By pressing the LOC/REM key a second time with the inverter disabled (or the MDI LOC/REM programmed as a key **C180a=Pushbutton**), the PID is disabled and the speed reference can be set directly from the Keypad page.

## 20.2. List of Parameters from P236 to P256

Table 28: List of Parameters P236 ÷ P256

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| P236 | Max. value of PID output | ENGINEERING | 836 | + 100.00% |
| P237 | Min. value of PID output | ENGINEERING | 837 | - 100.00% |
| P238 | Max. value of PID integral term | ENGINEERING | 838 | + 100.00% |
| P239 | Max. value of PID derivative term | ENGINEERING | 839 | + 100.00% |
| P240 | PID proportional constant | ENGINEERING | 840 | 1,000 |
| P241 | Multiplicative factor of **P240** | ENGINEERING | 841 | 0:1.0 |
| P242 | PID Integral time (multiples of **P244**) | ENGINEERING | 842 | 500*Tc (ms) |
| P243 | PID Derivative time (multiples of **P244**) | ENGINEERING | 843 | 0.001; 65,000*Ts (ms) |
| P244 | Cycle time of PID regulator: Tc | ENGINEERING | 844 | 5 ms |
| P245 | Min. value of PID reference | ENGINEERING | 845 | 0.00% |
| P246 | Max. value of PID reference | ENGINEERING | 846 | + 100.00% |
| P247 | Min. value of PID feedback | ENGINEERING | 847 | 0.00% |
| P248 | Max. value of PID feedback | ENGINEERING | 848 | + 100.00% |
| P249 | PID reference ramp up time | ENGINEERING | 849 | 0 s |
| P250 | PID reference ramp down time | ENGINEERING | 850 | 0 s |
| P251 | Unit of measure of PID ramp | ENGINEERING | 851 | 1: (0.1s) |
| P252 | PID ramp start rounding off | ENGINEERING | 852 | 50% |
| P253 | PID ramp end rounding off | ENGINEERING | 853 | 50% |
| P254 | Integral term activation threshold | ENGINEERING | 854 | 0.00% |
| P255 | Delay disable **START** with PID Out=**P237** | ENGINEERING | 855 | 0: (Disabled) |
| P256 | PID output gradient limit | ENGINEERING | 856 | 1 ms |
| P257 | Gain for PID measure scaling | ENGINEERING | 857 | 1.000 |

P236 Max. Value of PID Output

| P236 | | | |
|---|---|---|---|
| | Range | –10000 ÷ +10000 | –100.00 ÷ +100.00 % |
| | Default | +10000 | +100.00 % |
| | Level | ENGINEERING | |
| | Address | 836 | |
| | Function | This is the max. allowable value of PID regulator output.<br>This value is expressed as a percentage; its meaning depends on the programming in parameter **C294**, defining PID action.<br>Example: if **C294 = External Out**, PID regulator delivers a reference obtained based on the controlled variable and its setpoint. In this case, the PID output can be brought outside through an analog output. The matching between **P236** and the output value (see Analog Outputs menu) is user-defined.<br>If **C294 = Reference**, the PID regulator output is the motor speed/torque reference (the system will ignore any other reference source), parameter **P236** is a percentage referring to the max. value, considered as an absolute value, between the max. and the min. speed/torque reference of the active motor.<br>If **C294 = Add Reference**, the percentage in **P236** relates to the instant value of the speed/torque reference to be adjusted.<br>If a Frequency control is used, the PID regulator can be used to adjust the inverter output voltage; in this case, **P236** relates to the instant voltage value (E.g. if the inverter produces 50V by making an adjustment of 10% the inverter will produce 55V). | |

P237 Min. Value of PID Output

| P237 | | | |
|---|---|---|---|
| | Range | –10000 ÷ +10000 | –100.00 ÷ +100.00 % |
| | Default | –10000 | –100.00 % |
| | Level | ENGINEERING | |
| | Address | 837 | |
| | Function | This is the min. allowable value of PID regulator output.<br>For the value percent of **P237**, see description of parameter **P236**. | |

P238 Max. Value of Integral Term

| P238 | | | |
|---|---|---|---|
| | Range | 0 ÷ 10000 | –100.00 ÷ +100.00 % |
| | Default | 10000 | +100.00 % |
| | Level | ENGINEERING | |
| | Address | 838 | |
| | Function | This is the max. allowable value of the integral term. It is to be considered as an absolute value; the output value resulting from the integral term ranges from + **P238** to – **P238.** | |

P239 Max. Value of Derivative Term

| P239 | | | |
|---|---|---|---|
| | Range | 0 ÷ 10000 | –100.00 ÷ +100.00 % |
| | Default | 10000 | +100.00 % |
| | Level | ENGINEERING | |
| | Address | 839 | |
| | Function | This is the max. allowable value of the derivative term; it is to be considered as an absolute value; the output value resulting from the derivative term ranges from + **P239** to – **P239**. | |

P240 PID Proportional Constant

| P240 | | | |
|---|---|---|---|
| | Range | 0 ÷ 65000 | 0 ÷ 65.000 |
| | Default | 1000 | 1.000 |
| | Level | ENGINEERING | |
| | Address | 840 | |
| | Function | This is the value of the proportional coefficient. The PID regulator will use Kp resulting from the product of **P240** multiplied by **P241** (multiplicative factor). | |

P241 Multiplicative Factor of P240

| P241 | Range | 0÷2 | 0: 1.0<br>1: 10.0<br>2: 100.0 |
|---|---|---|---|
| | Default | 0 | 0: 1.0 |
| | Level | ENGINEERING | |
| | Address | 841 | |
| | Function | Multiplicative factor of the proportional coefficient.<br>This is used to obtain a wider range for the proportional coefficient used in PID regulator and ranging from 0.000 to 6500.0.<br>Supposing that the default values are used for **P240** and **P241**, the proportional coefficient used in the PID regulator is unitary: in case an error of 1% occurs between the reference and the controlled variable, the proportional term, representing one of the three values of the regulator output, will be 1%. | |

P242 PID Integral Time (multiples of P244)

| P242 | Range | 0 ÷ 65000 | 0: Disabled ÷ 65000 * Tc (ms) |
|---|---|---|---|
| | Default | 500 | 500* Tc (ms) |
| | Level | ENGINEERING | |
| | Address | 842 | |
| | Function | Constant **Ti** dividing the integral term of PID regulator:<br>**Ki** = 1/**Ti** = 1/(**P242***Ts)<br>It is expressed in sampling time units **Ts** (see **P244**). If this parameter is set to zero, the integral action is annulled. | |

P243 PID Derivative Time (multiples of P244)

| P243 | Range | 0 ÷ 65000 | 0 ÷ 65.000 * Tc (ms) |
|---|---|---|---|
| | Default | 0 | 0*Tc (ms) |
| | Level | ENGINEERING | |
| | Address | 843 | |
| | Function | Constant multiplying the derivative term of PID regulator. If this parameter is set to zero, the derivative action is disabled. | |

P244 Cycle Time of PID Regulator: Tc

| P244 | Range | 5 ÷ 65000 | 5 ÷ 65000 ms |
|---|---|---|---|
| | Default | 5 | 5 ms |
| | Level | ENGINEERING | |
| | Address | 844 | |
| | Function | This parameter determines the cycle time of PID regulator.<br>It is expressed in ms (multiples of 5 only).<br>Example: if **P244** = 1000 ms, the PID regulator cycle will be executed every second, and the output will be refreshed every second as well. | |

P245 Min. Value of PID Reference

| P245 | Range | –10000 ÷ +10000 | ±100.00% |
|---|---|---|---|
| | Default | 0 | 0.00% |
| | Level | ENGINEERING | |
| | Address | 845 | |
| | Function | This parameter defines the min. allowable value of the reference of the PID regulator.<br>The PID references are to be considered as percentage values; if analog references are selected, **P245** relates to the max. value of the selected analog input.<br>Example: Select analog input AIN1 as the PID reference and suppose that its max. and min. values are +10V and –10V respectively. If **P245** is –50%, this means that the PID reference will be saturated at –50% for voltage values lower than –5V. If digital reference sources are selected, the reference is already expressed as a percentage. | |

P246 Max. Value of PID Reference

| P246 | Range | –10000 ÷ +10000 | ±100.00% |
|---|---|---|---|
| | Default | +10000 | +100.00% |
| | Level | ENGINEERING | |
| | Address | 846 | |
| | Function | This parameter defines the max. allowable value of the PID reference. See description of **P245**. | |

P247 Min. Value of PID Feedback

| P247 | Range | –10000 ÷ +10000 | ±100.00% |
|---|---|---|---|
| | Default | 0 | 0.00% |
| | Level | ENGINEERING | |
| | Address | 847 | |
| | Function | This parameter defines the min. allowable value of the PID feedback. See description of **P245**. | |

P248 Max. Value of PID Feedback

| P248 | Range | –10000 ÷ +10000 | ±100.00% |
|---|---|---|---|
| | Default | +10000 | +100.00% |
| | Level | ENGINEERING | |
| | Address | 848 | |
| | Function | This parameter defines the max. allowable value of the PID feedback. See description of **P245**. | |

P249 PID Reference Ramp Up Time

| P249 | Range | *0 ÷ 32700* | Function of **P251** |
|---|---|---|---|
| | Default | 0 | 0 s |
| | Level | ENGINEERING | |
| | Address | 849 | |
| | Function | This parameter defines the ramp up time of the PID regulator reference from 0% to the max. allowable absolute value (max. {\|**P245**\|,\|**P246**\|}). | |

## P250 PID Reference Ramp Down Time

| P250 | | | |
|---|---|---|---|
| | Range | *0 ÷ 32700* | Function of **P251** |
| | Default | 0 | 0 s |
| | Level | ENGINEERING | |
| | Address | 850 | |
| | Function | This parameter defines the ramp down time of the PID regulator reference, from max. allowable value (max. {\|**P245**\|,\|**P246**\|}) to 0%. | |

## P251 Unit of measure of PID Ramp

| P251 | | | |
|---|---|---|---|
| | Range | *0 ÷ 3* | 0: 0.01 s<br>1: 0.1 s<br>2: 1.0 s<br>3: 10.0 s |
| | Default | 1 | 1: 0.10 s |
| | Level | ENGINEERING | |
| | Address | 851 | |
| | Function | This parameter defines the unit of measure for the PID reference ramp times.<br>It defines the unit of measure for the time of the third ramp of the PID reference **P249** and **P250**, so that the allowable range becomes 0s – 327000s. | |

Example:

| P251 | | Range P249 – P250 | |
|---|---|---|---|
| Value | Encoding | Min. | Max. |
| 0 | 0.01 s | 0 | 327.00 s |
| 1 | 0.1s | 0 | 3270.0 s |
| 2 | 1.0 s | 0 | 32700 s |
| 3 | 10.0 s | 0 | 327000 s |

NOTE

Factory-setting: the PID reference ramp is zero; if a given ramp time is set up, the ramp will be rounded off (50% at the beginning and at the end of the ramp). See parameters **P252** and **P253**.

## P252 PID Ramp Start Rounding Off

| P252 | | | |
|---|---|---|---|
| | Range | 0 ÷ 100 | 0 % ÷ 100% |
| | Default | 50 | 50% |
| | Level | ENGINEERING | |
| | Address | 852 | |
| | Function | This parameter sets the time period of the rounding off applied to the first stage of the ramps. It is expressed as a percentage of the ramp up/down time.<br>Example: ramp up of 5sec.: **P252 = 50%** means that the speed reference is limited in acceleration for the first 2.5 sec of the ramp up. | |

NOTE

When **P252** is used, the preset ramp time is increased by (**P252**%)/2.

P253 PID Ramp End Rounding Off

| P253 | Range | 0 ÷ 100 | 0 % ÷ 100% |
|---|---|---|---|
| | Default | 50 | 50% |
| | Level | ENGINEERING | |
| | Address | 853 | |
| | Function | As P252, but P253 sets the rounding off applied at the end of the ramps. | |

NOTE When P253 is used, the preset ramp time is increased by (P253%)/2.

P254 Integral Term Activation Threshold

| P254 | Range | 0.0 ÷ 5000 | 0.0 % ÷ 500.0% |
|---|---|---|---|
| | Default | 0 | 0.0 % |
| | Level | ENGINEERING | |
| | Address | 854 | |
| | Function | This parameter sets a threshold value below which the integrator is kept to zero. It has effect only when the PID regulator is used as a reference corrector or generator.<br>In this case, the threshold percentage value refers to the max. speed (or torque) absolute value set for the active motor.<br>The integral term is not calculated when the speed (or torque) percentage value expressed as an absolute value is lower than the value set in **P254**.<br>If **P254** is set to zero, the integrator is always activated. | |

P255 Delay Disable START with PID Out=P237

| P255 | Range | 0 ÷ 60000 | 0: Disabled<br>1 ÷ 60000 Ts |
|---|---|---|---|
| | Default | 0 | 0: Disabled |
| | Level | ENGINEERING | |
| | Address | 855 | |
| | Function | This parameter is expressed in time units of the PID regulator cycle (see **P244**) and it sets the max. time for the inverter operation with the PID regulator output continuously at its min. value.<br>If this is true for a time equal to the time set in **P255**, the inverter is automatically put on stand-by until the PID output value exceeds the min. value.<br>If **C149** is set as External Out or **P255** is set to zero, this function is disabled. | |

P256 PID Output Gradient Limit

| P256 | Range | 1 ÷ 65000 | 1 ÷ 65000 msec |
|---|---|---|---|
| | Default | 1 | 1ms |
| | Level | ENGINEERING | |
| | Address | 856 | |
| | Function | This parameter limits the max. acceleration for the PID regulator output.<br>The max. acceleration for the PID regulator output is equal to **100%** / **P256** [%/msec]. | |

P257 Gain for PID Measure Scaling

| P257 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32000 | 0.000 ; 32.000 |
| | Default | 1 | 1.000 |
| | Level | ENGINEERING | |
| | Address | 857 | |
| | Function | Gain for the scaling of PID measures **M023** ÷ **M025**.<br>This gain has effect only on the measures above. It does not affect the PID operation.<br>This parameter allows scaling if you want to display PID measures with a different unit of measure:<br>**M023** = **M020** * **P257**<br>**M024** = **M021** * **P257** | |

# 21. DIGITAL OUTPUTS MENU

## 21.1. Overview

The Digital Outputs menu includes those parameters allowing configuring the inverter digital outputs (MDO1, MDO2, MDO3 and MDO4).

NOTE The Digital Outputs menu may be accessed only if the access level is ADVANCED or ENGINEERING.

NOTE For a detailed hardware description of the digital outputs, refer to the Sinus Penta Installation Instructions manual.

NOTE Digital output MDO1 can be programmed only if the frequency output is not set up (**P200** = Disable; see ANALOG AND FREQUENCY OUTPUTS MENU).

### 21.1.1. FACTORY SETTING

The factory settings are as follows:
Digital output MDO1 is programmed as a zero speed relay that energizes when a given threshold is exceeded.
Digital output MDO2 is factory-set to control an electromechanical brake used for lifting applications.

Digital output MDO3 is active when the inverter is commutating.
Digital output MDO4 energizes when the inverter is not in emergency condition (no alarms tripped).

### 21.1.2. STRUCTURE OF DIGITAL OUTPUTS

The figures are an example of the functional structure of one of the four digital outputs (MDO1). The remaining three outputs (MDO2, MDO3 and MDO4) have a similar logical behaviour in reference to the relating parameters.

MDO1 (2,3,4) Programmed Digital Output Mode: P270, (P279, P288, P297)

It is possible to select the operating mode of the digital output, by choosing one of the available options:

Table 29: Digital Output Mode

| | |
|---|---|
| DISABLING | The selected digital output is disabled. |
| DIGITAL | The digital output depends on a selected digital signal and on the logic output function True/False. |
| DOUBLE DIGITAL | The digital output depends on 2 selected digital signals, on the logic function calculating the output value and on the logic output function True/False. |
| ANALOG | The digital output depends on a selected analog variable, which is tested through Test A and Test B, thus obtaining 2 digital signals; starting from their value, the selected logic function calculates the output value, whereas the logic output function True/False calculates the end value. |
| DOUBLE ANALOG | The digital outputs depends on 2 selected analog variables: Test A is performed for variable A, whilst Test B is performed for variable B, thus obtaining 2 digital signals; starting from their value, the selected logic function calculates the output value, whereas the logic output function True/False calculates the end value. |
| DOUBLE FULL | As for DOUBLE ANALOG or DOUBLE DIGITAL mode; although it is possible to select both digital signals and analog variables.<br>If you select a digital signal, its value (TRUE or FALSE) is used to calculate the selected logic function.<br>If you select an analog variable, the test selected for this variable is performed, and its result (TRUE or FALSE) is used to calculate the selected logic function. |
| BRAKE | As for ABS BRAKE below; although the selected variables are not expressed as absolute values, but depend on the selected tests. |
| ABS BRAKE | The ABS BRAKE mode allows to control the electromechanical brake of a motor used for lifting applications. To enable the relevant output, check that all the conditions depending on the inverter status are true (see description at the end of this section).<br>The ABS BRAKE mode is applied by selecting the measured (or estimated) speed value [51] as variable A and the output torque [60] as variable B.<br>Variables are considered as absolute values. |
| ABS LIFT | As ABS BRAKE, but the brake unlocks (digital output open) when a given torque value is attained, which is automatically determined based on the last torque value required in the previous stroke. |
| PWM MODE | The PWM mode may be selected for digital outputs MDO1 and MDO2 only (it cannot be selected for relay digital outputs MDO3 and MDO4).<br>The digital output becomes a low-frequency PWM output with a duty–cycle proportional to the value of the selected analog output. |

MDO1 (2,3,4) Selecting Variable A: P271, (P280, P289, P298)

This selects the digital signal or the analog variable used for Test A (set with **P273/P282/P291/P300**).
The whole list of selectable items and their description appears at the end of this section (see Table 30).
If a digital signal is selected, Test A is not performed: therefore, the comparison value for Test A (set with **P275/P284/P293/P302**) has no meaning.

NOTE

This parameter can be accessed only if the operating mode of the digital output concerned is other than zero. Example: MDO1 **P270**≠0.

MDO1 (2,3,4) Selecting Variable B: P272, (P281, P290, P299)

This selects another digital signal or the analog variable used for Test B (set with **P274/P283/P292/P301**).
The whole list of selectable items and their description appears at the end of this section (see Table 30).
If a digital signal is selected, Test B is not performed: therefore, the comparison value for Test B (set with **P276/P285/P294/P303**) has no meaning.

NOTE

This parameter cannot be accessed if the operating mode of the digital output concerned is equal to 3 or 9. Example: MDO1 **P270**=3 OR **P270**=9.

**Table 30: List of the Selectable Digital Signals and Analog Variables**

Selectable digital signals (BOOLEAN):

| Selectable Value | Description |
|---|---|
| D0: Disable | Always FALSE: 0 |
| D1: Run Ok | Inverter running (no standby) |
| D2: Ok On | Inverter OK: no alarms tripped |
| D3: Alarm | Inverter alarm tripped |
| D4: Run ALR | Inverter KO: alarm tripped when the inverter is running |
| D5: Fwd Run | Speed (measured or estimated) higher than +0.5 rpm |
| D6: Rev Run | Speed (measured or estimated) lower than –0.5 rpm |
| D7: Lim. MOT | Inverter in limiting mode operating as a motor |
| D8: Lim.GEN | Inverter in limiting mode operating as a generator |
| D9: Limiting | Inverter in limiting mode (generator or motor) |
| D10: Prec. Ok | Capacitor Precharge relay closing |
| D11: PID MAX | PID output max. saturation |
| D12: PID MIN | PID output min. saturation |
| D13: MDI 1 | Selected digital input MDI1 (remote OR physical) |
| D14: MDI 2 | Selected digital input MDI2 (remote OR physical) |
| D15: MDI 3 | Selected digital input MDI3 (remote OR physical) |
| D16: MDI 4 | Selected digital input MDI4 (remote OR physical) |
| D17: MDI 5 | Selected digital input MDI5 (remote OR physical) |
| D18: MDI 6 | Selected digital input MDI6 (remote OR physical) |
| D19: MDI 7 | Selected digital input MDI7 (remote OR physical) |
| D20: MDI 8 | Selected digital input MDI8 (remote OR physical) |
| D21: MDI ENABLE | Selected digital input ENABLE (remote AND physical) |
| D22: MDI ENABLE S | Selected digital input ENABLE S (remote AND physical) |
| D23: MDI 1 DL | Digital input MDI1 (remote OR physical) DELAYED by timers MDI |
| D24: MDI 2 DL | Digital input MDI2 (remote OR physical) DELAYED by timers MDI |
| D25: MDI 3 DL | Digital input MDI3 (remote OR physical) DELAYED by timers MDI |
| D26: MDI 4 DL | Digital input MDI4 (remote OR physical) DELAYED by timers MDI |
| D27: MDI 5 DL | Digital input MDI5 (remote OR physical) DELAYED by timers MDI |
| D28: MDI 6 DL | Digital input MDI6 (remote OR physical) DELAYED by timers MDI |
| D29: MDI 7 DL | Digital input MDI7 (remote OR physical) DELAYED by timers MDI |
| D30: MDI 8 DL | Digital input MDI8 (remote OR physical) DELAYED by timers MDI |
| D31: ENABLE DL | Digital input ENABLE (remote AND physical) DELAYED by timers MDI |
| D32: Trk.Err | Speed tracking error: \|SetPoint – Measure\| > Error_Par exceeding one timeout |
| D33: Fan Flt | Fault of the cooling fan |
| D34: Fbus C1 | Command 1 from field bus |
| D35: Fbus C2 | Command 2 from field bus |
| D36: Fbus C3 | Command 3 from field bus |
| D37: Fbus C4 | Command 4 from field bus |
| D38: FireMod | Fire Mode function |
| D39: Local | LOCAL Mode |
| D40: Speed OK | Constant speed reference reached |
| D41: Reserved | |
| D42: Reserved | |
| D43: Reserved | |
| D44: Reserved | |
| D45: Reserved | |
| D46: Reserved | |
| D47: Reserved | |
| D48: Reserved | |
| D49: Reserved | |

Selectable analog variables:

| Selectable Value | Full-scale Value | Kri | Description |
|---|---|---|---|
| A50: GROUND | | | Analog 0 Volt |
| A51: Speed | 10000 rpm | 1 | Motor speed |
| A52: Spd REF. | 10000 rpm | 1 | Speed reference at constant speed |
| A53: RampOut | 10000 rpm | 1 | Speed reference when ramps are over |
| A54: MotFreq | 1000.0 Hz | 10 | Frequency produced by the inverter |
| A55: MotCurr | 1000.0 A | 10 | Current RMS |
| A56: OutVolt | 1000.0 V | 10 | Output voltage RMS |
| A57: Out Pow | 1000.0 kW | 10 | Output power |
| A58: DC Vbus | 1000.0 V | 10 | DC-link voltage |
| A59: Torq.REF | 100.00 % | 100 | Torque reference at constant speed |
| A60: Torq.DEM | 100.00 % | 100 | Torque demand |
| A61: Torq.OUT | 100.00 % | 100 | Estimation of the torque output |
| A62: Torq.LIM | 100.00 % | 100 | Torque limit setpoint |
| A63: PID REF | 100.00 % | 100 | PID reference at constant speed |
| A64: PID RMP | 100.00 % | 100 | PID reference when ramps are over |
| A65: PID Err | 100.00 % | 100 | Error between PID reference and PID feedback |
| A66: PID Fbk | 100.00 % | 100 | PID feedback |
| A67: PID Out | 100.00 % | 100 | PID output |
| A68: REF | 100.00 % | 100 | Analog input REF |
| A69: AIN1 | 100.00 % | 100 | Analog input AIN1 |
| A70: AIN2/Pt | 100.00 % | 100 | Analog input AIN2/PTC |
| A71: EncIn | 10000 rpm | 1 | Speed read from encoder and used as a reference |
| A72: PulseIn | 100.00 kHz | 100 | Frequency input |
| A73: Flux REF | 1.0000 Wb | 1 | Flux reference at constant speed |
| A74: Flux | 1.0000 Wb | 1 | Active flux reference |
| A75: Iq REF | 1000.0 A | 10 | Current reference over axis q |
| A76: Id REF | 1000.0 A | 10 | Current reference over axis d |
| A77: Iq | 1000.0 A | 10 | Current measure over axis q |
| A78: Id | 1000.0 A | 10 | Current measure over axis d |
| A79: Volt Vq | 1000.0 V | 10 | Voltage over axis q |
| A80: Volt Vd | 1000.0 V | 10 | Voltage over axis d |
| A81: Cosine | 100.00 % | 100 | Waveform: Cosine |
| A82: Sine | 100.00 % | 100 | Waveform: Sine |
| A83: Angle | 100.00 % | 100 | Electric angle of delivered Vu |
| A84: +10V | | | +10 Volt Analog |
| A85: –10V | | | –10 Volt Analog |
| A86: Reserved | | | |
| A87: SqrWave | 100.00 % | 100 | Square wave |
| A88: Saw Wave | 100.00 % | 100 | Saw wave |
| A89: HtsTemp. | 100.00 °C | 100 | Heatsink temperature |
| A90: AmbTemp. | 100.00 °C | 100 | Ambient temperature |
| A91: A Zero 1 | | | 0 Volt Analog |
| A92: A Zero 2 | | | 0 Volt Analog |
| A93: A Zero 3 | | | 0 Volt Analog |
| A94: A Zero 4 | | | 0 Volt Analog |
| A95: A Zero 5 | | | 0 Volt Analog |
| A96: A Zero 6 | | | 0 Volt Analog |
| A97: A Zero 7 | | | 0 Volt Analog |
| A98: A Zero 8 | | | 0 Volt Analog |
| A99: A Zero 9 | | | 0 Volt Analog |
| Minimum value = –3.2*Full-scale value<br>Maximum value = 3.2*Full-scale value<br>MODBUS Value = Parameter value* Kri | | | |

Digit. MDO1 (2,3,4) Testing Variable A: P273, (P282, P291, P300)

If an analog variable is selected, a logic TEST is performed to obtain a Boolean signal TRUE/FALSE.
Seven different tests are available, that can be performed for selected variable A and its comparing value A:

Table 31: Test Functions

| | |
|---|---|
| GREATER THAN | Selected variable > comparing value |
| GREATER THAN/EQUAL TO | Selected variable ≥ comparing value |
| LOWER | Selected variable < comparing value |
| LOWER THAN/EQUAL TO | Selected variable ≤ comparing value |
| ABS, GREATER THAN | Absolute value (selected variable) > comparing value |
| ABS, GREATER THAN/EQUAL TO | Absolute value (selected variable) ≥ comparing value |
| ABS, LOWER | Absolute value (selected variable) < comparing value |
| ABS, LOWER THAN/EQUAL TO | Absolute value (selected variable) ≤ comparing value |

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MDO1 **P270**>2.

Digit. MDO1 (2,3,4) Testing Variable B: P274, (P283, P292, P301)

If an analog variable is selected, a logic TEST is performed to obtain a Boolean signal TRUE/FALSE.
Seven different tests are available, that can be performed for selected variable B and its comparing value B (see Table 31).

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2 and < 9. Example: MDO1 2<**P270**<9.

Reference threshold for P271 (P280, P289, P298) Digit. MDO1: P275, (P284, P293, P302)

This defines the comparing value of Test A with the first selected variable.

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MDO1 **P270**>2.

Reference threshold for P272 (P281, P290, P299) Digit. MDO2 (3,4): P276, (P285, P294, P303)

This defines the comparing value of Test B with the first selected variable.

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MDO1 **P270**>2.

MDO1: Function Applied to the Result of Tests A and B: P277, (P286, P295, P304)

A logic function is applied to the two Boolean signals obtained in order to obtain the output Boolean signal TRUE/FALSE.
Six different tests may be performed for variable (A) using the comparing value and variable (B).

(A) OR (B): The selected digital output is enabled when at least one of the two conditions below is true (this function also allows enabling the selected digital input based on one test only).

| (A) OR (B) | | |
|---|---|---|
| Test A | Test B | Output |
| 0 | 0 | **0** |
| 1 | 0 | **1** |
| 0 | 1 | **1** |
| 1 | 1 | **1** |

(A) SET (B) RESET: The selected digital output is activated as the output of a Flip Flop Set Reset whose inputs are signal A and signal B. This function can be used in case of hysteresis. The output status (Q) depends on the previous value (Q hold) and on the result of the two tests. Test A is the Set command; Test B is the Reset command.
Example: Suppose that the output enables only when the motor speed exceeds 50rpm and disables when the motor speed drops below 5 rpm. To do so, assign the first condition to Test A, representing the Set command for Flip Flop (**P271** = Motor Speed, **P273** >, **P275** = 50rpm), and assign the second condition to Test B, representing the Reset command (**P272** = Motor Speed, **P274** <=, **P276** = 5rpm). A more detailed example is described at the end of this section.

| Flip Flop Set Reset | | | |
|---|---|---|---|
| Q hold | Test A (Set) | Test B (Reset) | Output Q |
| 0 | 0 | 1 | **0** |
| 0 | 0 | 0 | **0** |
| 0 | 1 | 1 | **0** |
| 0 | 1 | 0 | **1** |
| 1 | 0 | 1 | **0** |
| 1 | 0 | 0 | **1** |
| 1 | 1 | 1 | **1** |
| 1 | 1 | 0 | **1** |

(A) AND (B): The selected digital output enables when both conditions are true.

| (A) AND (B) | | |
|---|---|---|
| Test A | Test B | Output |
| 0 | 0 | **0** |
| 1 | 0 | **0** |
| 0 | 1 | **0** |
| 1 | 1 | **1** |

(A) XOR (B): The selected digital output enables when either one or the other condition is true, but not both at the same time.

| (A) XOR (B) | | |
|---|---|---|
| Test A | Test B | Output |
| 0 | 0 | **0** |
| 1 | 0 | **1** |
| 0 | 1 | **1** |
| 1 | 1 | **0** |

(A) NOR (B): The selected digital output enables when no condition is true.

| (A) NOR (B) | | |
|---|---|---|
| Test A | Test B | Output |
| 0 | 0 | **1** |
| 1 | 0 | **0** |
| 0 | 1 | **0** |
| 1 | 1 | **0** |

(A) NAND (B): The selected digital output enables when no condition is true or when only one of the two conditions is true.

| (A) NAND (B) | | |
|---|---|---|
| Test 1 | Test 2 | Output |
| 0 | 0 | **1** |
| 1 | 0 | **1** |
| 0 | 1 | **1** |
| 1 | 1 | **0** |

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2 and <9. Example: MDO1 2<**P270**<9.

MDO1 (2,3,4): Logic applied at the Digital Output: P278, (P287, P296, P305)
At the end of the processing chain, it is possible to reverse the logic of the Boolean signal.
The user can choose whether the logic level of the digital output is POSITIVE or NEGATIVE.
(0) FALSE = a logic negation is applied (NEGATIVE logic)
(1) TRUE = no negation is applied (POSITIVE logic)

NOTE This parameter can be accessed only if the operating mode of the selected digital output is other than zero. Example: MDO1 **P270**≠0.

## 21.2. Programmable Modes (Diagrams)

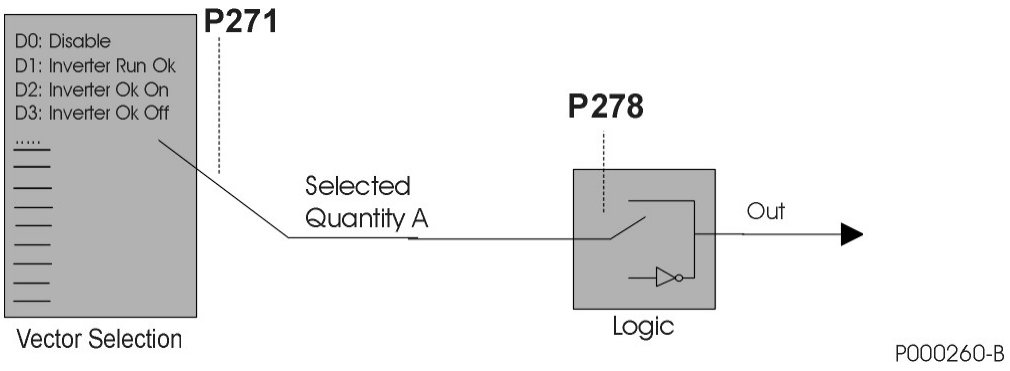



Figure 25: DIGITAL Mode

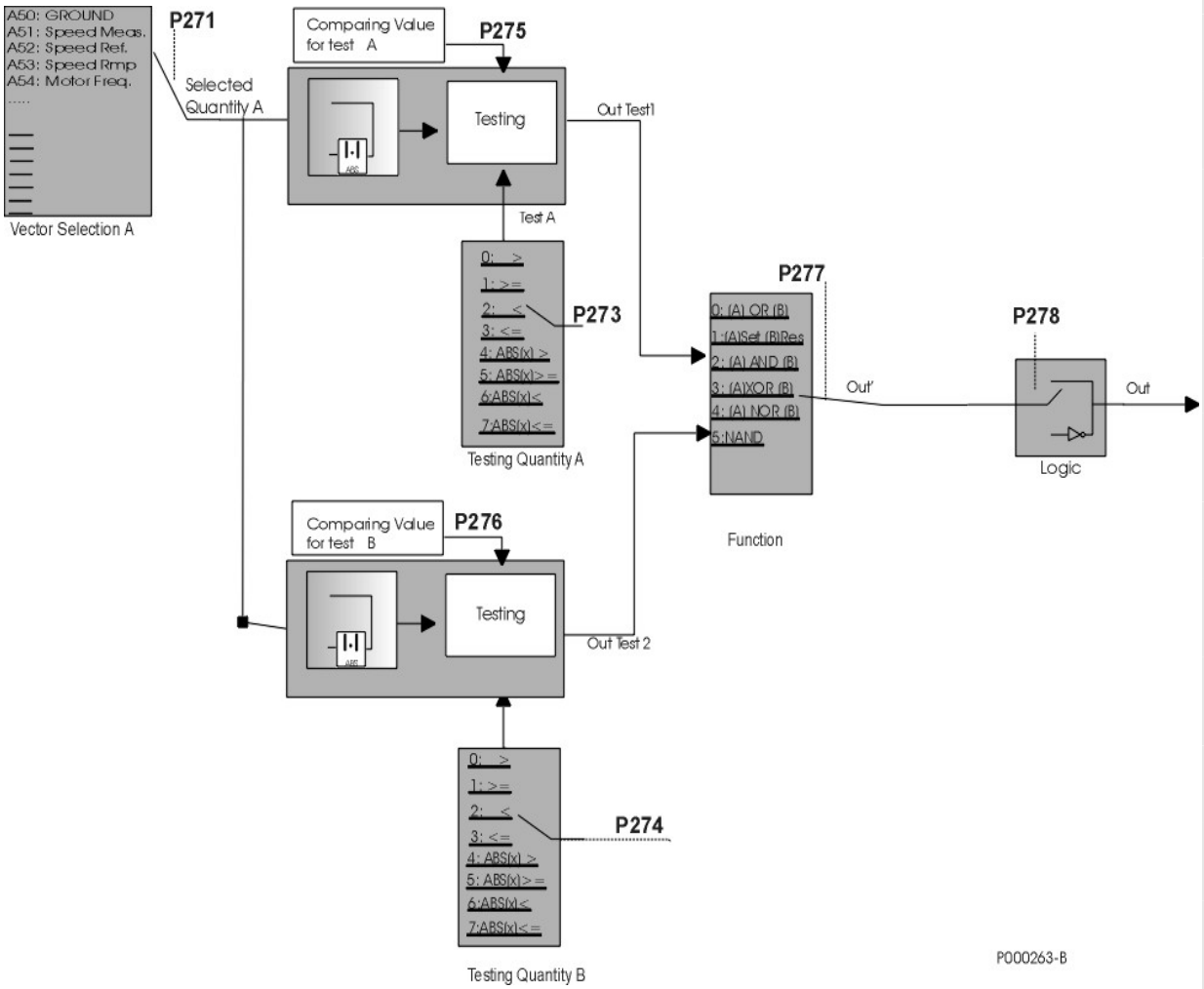



Figure 26: ANALOG Mode

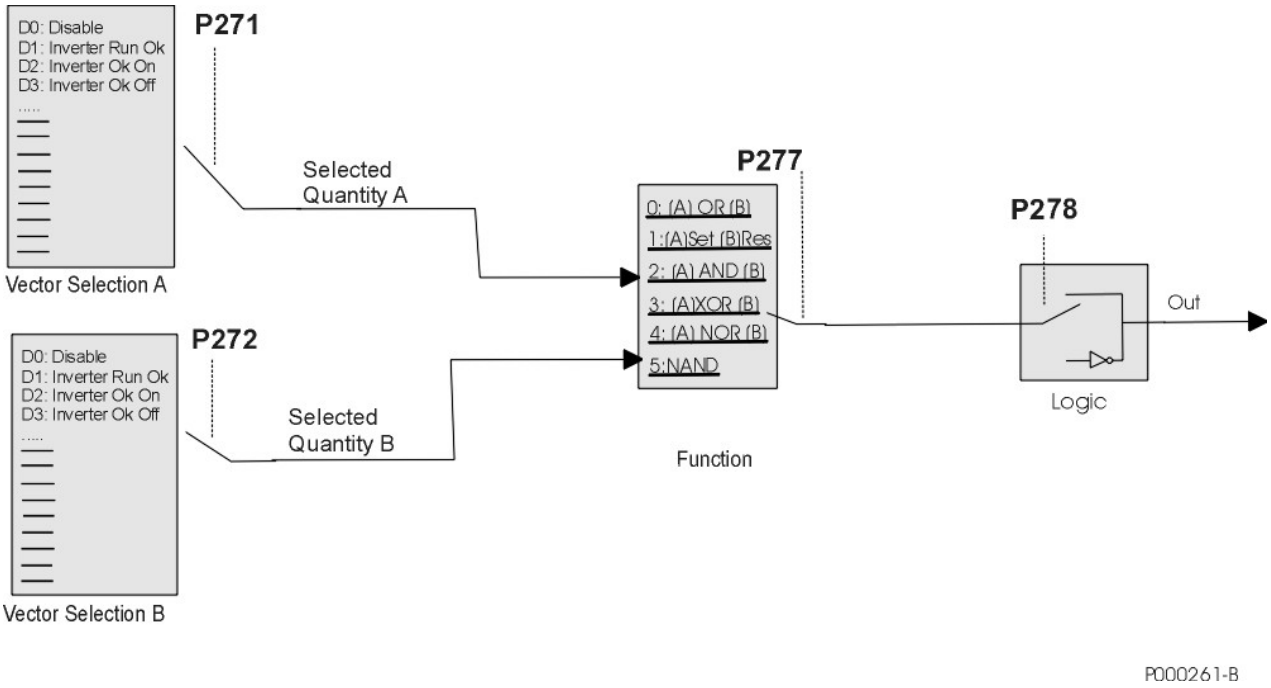



Figure 27: DOUBLE DIGITAL Mode

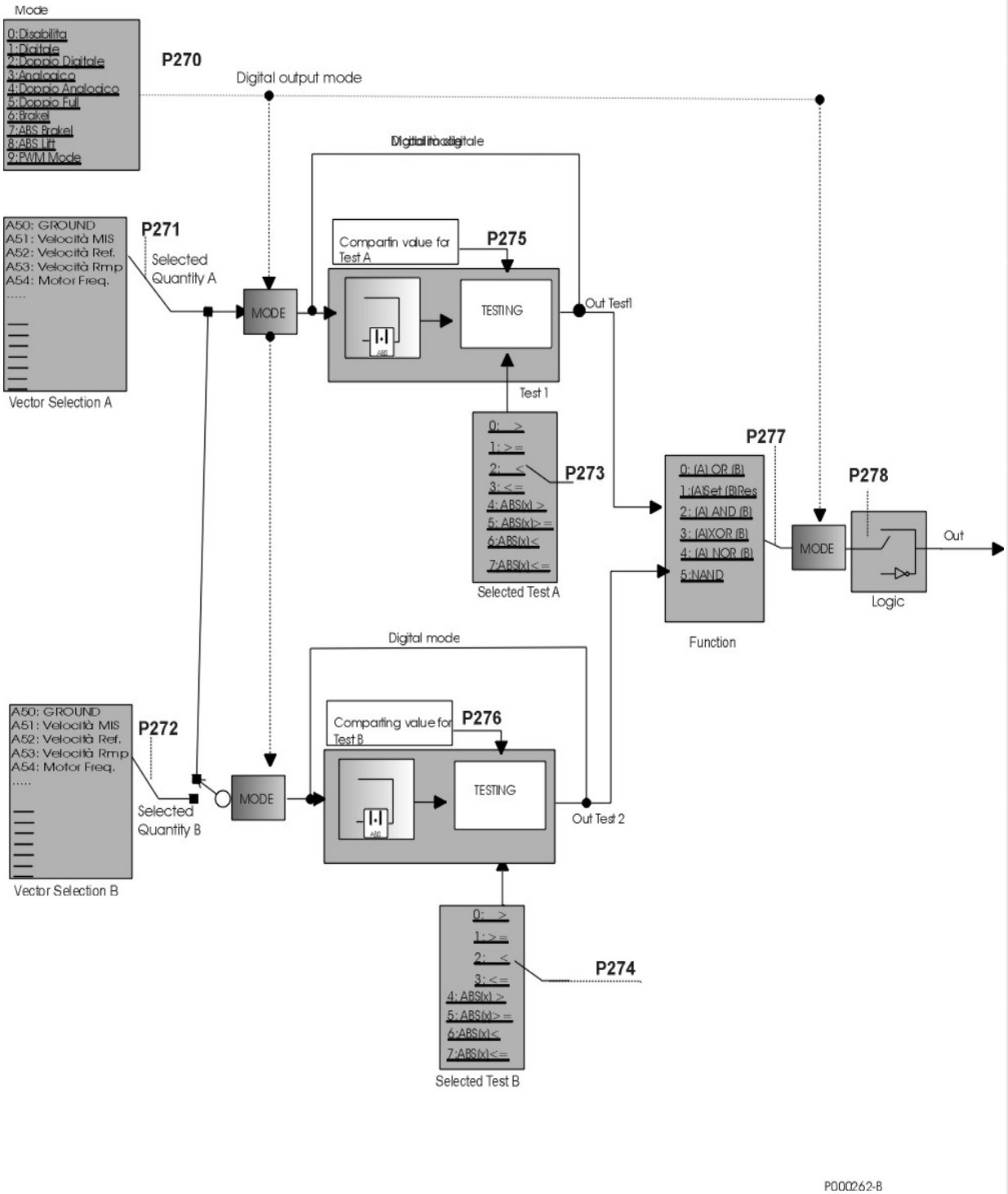



Figure 28: General Structure of the Parameterization of a Digital Output

## 21.3. Examples

This section illustrates some examples.
A table stating the set up of the parameters used is given for each example.
Parameters highlighted in grey have no effect, due to the preselected setting.

Example 1: Digital Output for Inverter OK Digital Command (Default: Digital Output MDO3)

Table 32: Parameterization for Example 1

| | | |
|---|---|---|
| **P288** | MDO3: Digital output mode | DIGITAL |
| **P289** | MDO3: Variable A selection | D2: Inverter Ok On |
| **P290** | MDO3: Variable B selection | |
| **P291** | MDO3: Testing variable A | |
| **P292** | MDO3: Testing variable B | |
| **P293** | MDO3: Comparing value for Test A | |
| **P294** | MDO3: Comparing value for Test B | |
| **P295** | MDO3: Function applied to the result of the two tests | |
| **P296** | MDO3: Output logic level | TRUE |

The digital output status depends on the Boolean variable "Inverter Ok", which is FALSE only when an alarm trips.

Example 2: Digital Output for Digital Command Inverter Run OK (Default: Digital Output MDO4)

Table 33: Parameterization for Example 2

| | | |
|---|---|---|
| **P297** | MDO4: Digital output mode | DIGITAL |
| **P298** | MDO4: Variable A selection | D1: Inverter Run Ok |
| **P299** | MDO4: Variable B selection | |
| **P300** | MDO4: Testing variable A | |
| **P301** | MDO4: Testing variable B | |
| **P302** | MDO4: Comparing value for Test A | |
| **P303** | MDO4: Comparing value for Test B | |
| **P304** | MDO4: Function applied to the result of the two tests | |
| **P305** | MDO4: Output logic level | TRUE |

The digital output status depends on the Boolean variable "Inverter Run Ok", which is TRUE only when the inverter is modulating (IGBTs on).

Example 3: Digital Output for Speed Thresholds

Suppose that a digital output energizes if the motor speed exceeds 100rpm as an absolute value, and de-energizes when the motor speed is lower than or equal to 20rpm (as an absolute value). Parameter P270 sets ABS mode, so that the selected variables are considered as absolute values. The condition "greater than" is selected for test 1, and "lower than/equal to" is selected for test 2.

**Table 34: Parameterization for Example 3**

| | | |
|---|---|---|
| **P270** | MDO1: Digital output mode | ANALOG |
| **P271** | MDO1: Variable A selection | A51: Speed MEA |
| **P272** | MDO1: Variable B selection | |
| **P273** | MDO1: Testing variable A | ABS(x) > |
| **P274** | MDO1: Testing variable B | ABS (x) ≤ |
| **P275** | MDO1: Comparing value for Test A | 100.00 rpm |
| **P276** | MDO1: Comparing value for Test B | 20.00 rpm |
| **P277** | MDO1: Function applied to the result of the two tests | (A) Set (B) Reset |
| **P278** | MDO1: Output logic level | TRUE |

Both tests are performed over the motor speed; **P271**, **P272** are set to motor speed. The values of reference for the two tests are 100rpm and 20rpm; the function applied is Flip Flop Set Reset and the output is considered as a true logic. Test 1 is the Set signal of the Flip Flop and Test 2 is the Reset signal.

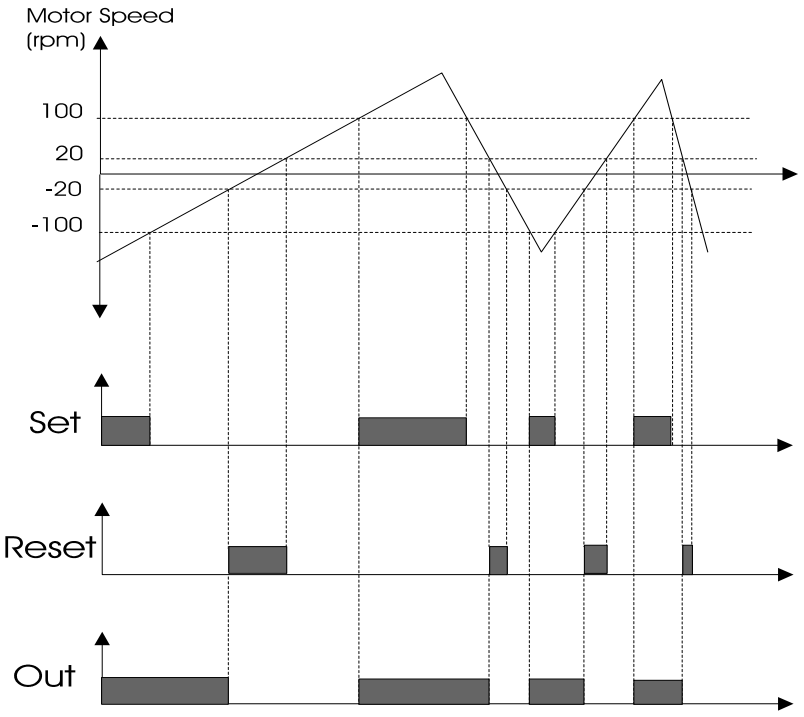



**Figure 29: Digital Output for Speed Thresholds (Example)**

Example 4: Digital Output for Electromechanical Brake for Lifting Applications (Default: Digital Output MDO4)

Table 35: Parameterization for Example 4

| | | |
|---|---|---|
| **P297** | MDO4: Digital output mode | ABS BRAKE |
| **P298** | MDO4: Variable A selection | A61: Torque Output |
| **P299** | MDO4: Variable B selection | A51: Speed MEA |
| **P300** | MDO4: Testing variable A | > |
| **P301** | MDO4: Testing variable B | ≤ |
| **P302** | MDO4: Comparing value for Test A | 20.00% |
| **P303** | MDO4: Comparing value for Test B | 50.00 rpm |
| **P304** | MDO4: Function applied to the result of the two tests | (A) Set (B) Reset |
| **P305** | MDO4: Output logic level | TRUE |

The digital output energizes only if no alarm trips. The torque demand is greater than **P302** = 20.00% (Set). The digital output de-energizes if an alarm trips or if the decelerating speed is lower than the speed value set in **P303** = 50% (reset).

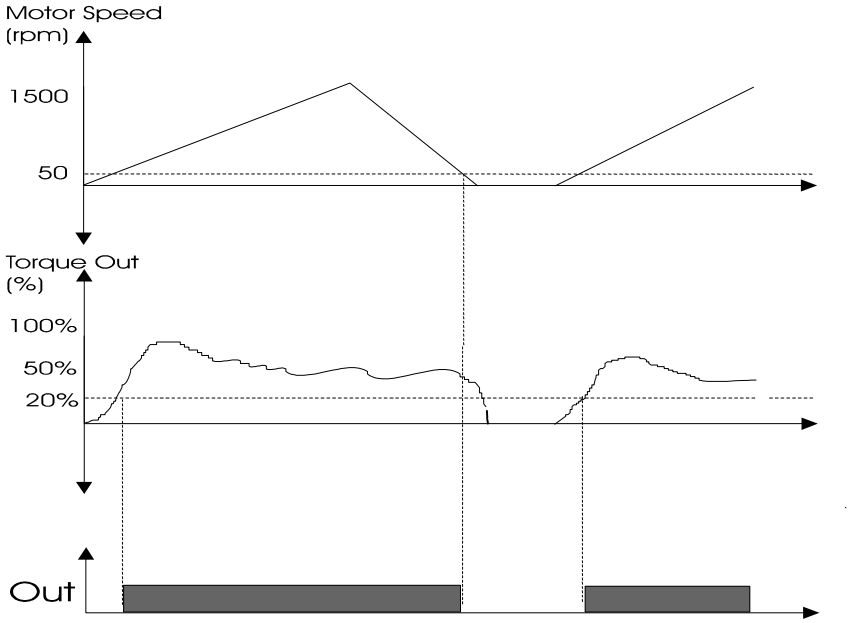



Figure 30: Electromechanical Brake Command (Example )

**CAUTION** Always use the NO contact of the digital output for the electromechanical brake command.

**NOTE** For details on using the electromechanical brake for lifting applications, see also the BRIDGE CRANE MENU

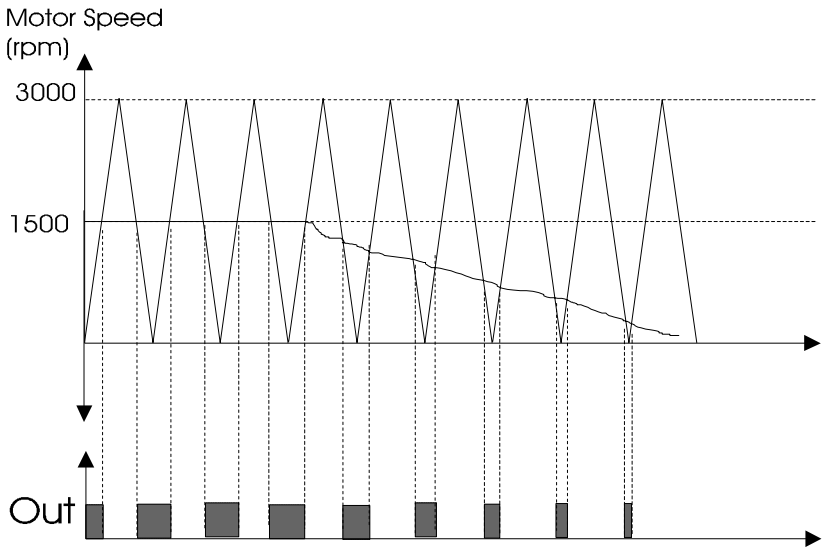
Example 5: Using PWM Function

Suppose that the motor of a machine tool is controlled by an inverter. The tool must be lubricated based on the cutting speed. At max. cutting speed, the electrovalve controlling lubrication must work for 0.5 sec with a frequency of 1Hz (time period of 1 sec.): at max. speed, a duty cycle of 50% (Ton/T) is required, with a time period of 1 second; the time when the electrovalve opens is inversely proportional to the cutting speed.
Spd1 is the max. cutting speed and dtc1 is the duty cycle required; the saw carrier frequency required for PWM must be 1 Hz (**P213**), min. value 0rpm (when speed = 0rpm, the electrovalve is disabled) and max. value = Spd1 100/ dtc1 = 2*Spd1.
Supposing that the tool can rotate in both directions, that Spd1 = 1500rpm and that digital output MDO2 is used, parameters are set as follows:

**Table 36: Parameterization for Example 5**

| | | |
|---|---|---|
| **P270** | MDO1: Digital output mode | PWM MODE |
| **P271** | MDO1: Variable A selection | A52: Speed Ref. |
| **P272** | MDO1: Variable B selection | |
| **P273** | MDO1: Testing variable A | > |
| **P274** | MDO1: Testing variable B | |
| **P275** | MDO1: Comparing value for Test A | 3000.00 rpm |
| **P276** | MDO1: Comparing value for Test B | 0.0 rpm |
| **P277** | MDO1: Function applied to the result of the two tests | |
| **P278** | MDO1: Output logic level | TRUE |
| **P215** | Saw signal frequency | 0.01Hz |

Parameter **P215** in the Analog Outputs Menu sets the frequency of the saw wave, i.e. PWM frequency of the digital output.
In PWM mode, parameter **P275** sets the max. value (peak value) of the saw wave, while parameter **P276** sets the min. value of the saw wave.
The test selected with **P273** is performed between the analog variable selected in **P271** and the saw wave.



## 21.4. List of Parameters from P270 to P305

Table 37: List of Parameters P270 ÷ P305

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| P270 | MDO1: Digital output mode | ADVANCED | 870 | 3:ANALOG |
| P271 | MDO1: Selecting variable A | ADVANCED | 871 | A51: MEA Speed |
| P272 | MDO1: Selecting variable B | ADVANCED | 872 | A51: MEA Speed |
| P273 | MDO1: Testing variable A | ADVANCED | 873 | 0:> |
| P274 | MDO1: Testing variable B | ADVANCED | 874 | 3: ≤ |
| P275 | MDO1: Comparing value for Test A | ADVANCED | 875 | 50 rpm |
| P276 | MDO1: Comparing value for Test B | ADVANCED | 876 | 10 rpm |
| P277 | MDO1: Function applied to the result of the 2 tests | ADVANCED | 877 | 1: (A) SET (B) RESET |
| P278 | MDO1: Output logic level | ADVANCED | 878 | 1: TRUE |
| P279 | MDO2: Digital output mode | ADVANCED | 879 | 6: BRAKE |
| P280 | MDO2: Selecting variable A | ADVANCED | 880 | A60: Torque Demand |
| P281 | MDO2: Selecting variable B | ADVANCED | 881 | A51 : MEA Speed |
| P282 | MDO2: Testing variable A | ADVANCED | 882 | 0 : > |
| P283 | MDO2: Testing variable B | ADVANCED | 883 | 3: ≤ |
| P284 | MDO2: Comparing value for Test A | ADVANCED | 884 | 20% |
| P285 | MDO2: Comparing value for Test B | ADVANCED | 885 | 50 rpm |
| P286 | MDO2: Function applied to the result of the 2 tests | ADVANCED | 886 | 1: (A) SET (B) RESET |
| P287 | MDO2: Output logic level | ADVANCED | 887 | 1: TRUE |
| P288 | MDO3: Digital output mode | ADVANCED | 888 | 1: DIGITAL |
| P289 | MDO3: Selecting variable A | ADVANCED | 889 | D2 : Inverter Ok On |
| P290 | MDO3: Selecting variable B | ADVANCED | 890 | D2 : Inverter Ok On |
| P291 | MDO3: Testing variable A | ADVANCED | 891 | 0 : > |
| P292 | MDO3: Testing variable B | ADVANCED | 892 | 0 : > |
| P293 | MDO3: Comparing value for Test A | ADVANCED | 893 | 0 |
| P294 | MDO3: Comparing value for Test B | ADVANCED | 894 | 0 |
| P295 | MDO3: Function applied to the result of the 2 tests | ADVANCED | 895 | 0: (A) OR (B) |
| P296 | MDO3: Output logic level | ADVANCED | 896 | 1: TRUE |
| P297 | MDO4: Digital output mode | ADVANCED | 897 | 1: DIGITAL |
| P298 | MDO4: Selecting variable A | ADVANCED | 898 | D1: Inverter Run Ok |
| P299 | MDO4: Selecting variable B | ADVANCED | 899 | D1: Inverter Run Ok |
| P300 | MDO4: Testing variable A | ADVANCED | 900 | 0 : > |
| P301 | MDO4: Testing variable B | ADVANCED | 901 | 0 : > |
| P302 | MDO4: Comparing value for Test A | ADVANCED | 902 | 0 |
| P303 | MDO4: Comparing value for Test B | ADVANCED | 903 | 0 |
| P304 | MDO4: Function applied to the result of the 2 tests | ADVANCED | 904 | 0: (A) OR (B) |
| P305 | MDO4: Output logic level | ADVANCED | 905 | 1: TRUE |

P270 MDO1: Digital Output Mode

| | | | |
|---|---|---|---|
| P270 | Range | 0 ÷ 9 | 0: DISABLE<br>1: DIGITAL<br>2: DOUBLE DIGITAL<br>3: ANALOG<br>4: DOUBLE ANALOG<br>5: DOUBLE FULL<br>6: BRAKE<br>7: ABS BRAKE<br>8: ABS LIFT<br>9: PWM MODE |
| | Default | 3 | 3: ANALOG |
| | Level | ADVANCED | |
| | Address | 870 | |
| | Function | This parameter defines the operating mode of **digital output 1**.<br>The different operating modes are described in the section at the beginning of the chapter. | |

NOTE

Digital output MDO1 can be programmed only if the frequency output is not set up: **P200** = Disable (see ANALOG AND FREQUENCY OUTPUTS MENU).

P271 MDO1: Selecting Variable A

| | | | |
|---|---|---|---|
| P271 | Range | 0 ÷ 99 | see Table 30 |
| | Default | 51 | A51: Speed MEA |
| | Level | ADVANCED | |
| | Address | 871 | |
| | Function | This parameter selects the digital signal used to calculate the value of digital output **MDO1**.<br>It selects an analog variable used to the value of digital input **MDO1** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P272 MDO1: Selecting Variable B

| | | | |
|---|---|---|---|
| P272 | Range | 0 ÷ 99 | see Table 30 |
| | Default | 51 | A51: Speed MEA |
| | Level | ADVANCED | |
| | Address | 872 | |
| | Function | This parameter selects the second digital signal used to calculate the value of digital output **MDO1**.<br>It selects an analog variable used to calculate the value of digital input **MDO1** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P273 MDO1: Testing Variable A

| | | | |
|---|---|---|---|
| P273 | Range | 0 ÷ 7 | 0: ><br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) ><br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
| | Default | 0 | 0: > |
| | Level | ADVANCED | |
| | Address | 873 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P271** using **P275** as a comparing value. | |

P274 MDO1: Testing Variable B

| | | | |
|---|---|---|---|
| P274 | Range | 0 ÷ 7 | 0: ><br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) ><br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
| | Default | 3 | 3: ≤ |
| | Level | ADVANCED | |
| | Address | 874 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P272** using **P276** as a comparing value. | |

P275 MDO1: Comparing Value for Test A

| | | | |
|---|---|---|---|
| P275 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable A,<br>see Table 30 |
| | Default | 50 | 50 rpm |
| | Level | ADVANCED | |
| | Address | 875 | |
| | Function | This parameter defines the comparing value with the selected variable for test A. | |

P276 MDO1: Comparing Value for Test B

| | | | |
|---|---|---|---|
| P276 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable B,<br>see Table 30 |
| | Default | 10 | 10 rpm |
| | Level | ADVANCED | |
| | Address | 876 | |
| | Function | This parameter defines the comparing value with the selected variable for test B. | |

## P277 MDO1: Function Applied to the Result of the 2 Tests

| | | | |
|---|---|---|---|
| P277 | Range | 0 ÷ 5 | 0: (A) OR (B)<br>1: (A) SET (B) RESET<br>2: (A) AND (B)<br>3: (A) XOR (B)<br>4: (A) NOR (B)<br>5: (A) NAND (B) |
| | Default | 1 | 1: (A) SET (B) RESET |
| | Level | ADVANCED | |
| | Address | 877 | |
| | Function | This parameter determines the logic function applied to the result of the two tests to calculate the output value. | |

## P278 MDO1: Output Logic Level

| | | | |
|---|---|---|---|
| P278 | Range | 0–1 | 0: FALSE<br>1: TRUE |
| | Default | 1 | 1: TRUE |
| | Level | ADVANCED | |
| | Address | 878 | |
| | Function | Digital output logic function MDO1 to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied. | |

## P279 MDO2: Digital Output Mode

| | | | |
|---|---|---|---|
| P279 | Range | 0 ÷ 9 | 0: DISABLE<br>1: DIGITAL<br>2: DOUBLE DIGITAL<br>3: ANALOG<br>4: DOUBLE ANALOG<br>5: DOUBLE FULL<br>6: BRAKE<br>7: ABS BRAKE<br>8: ABS LIFT<br>9: PWM MODE |
| | Default | 6 | 1: BRAKE |
| | Level | ADVANCED | |
| | Address | 879 | |
| | Function | This parameter defines the operating mode of **digital output 2**. The different operating modes are described in the section at the beginning of this chapter. | |

## P280 MDO2: Selecting Variable A

| | | | |
|---|---|---|---|
| P280 | Range | 0 ÷ 99 | See Table 30 |
| | Default | 60 | A60: Torque Demand |
| | Level | ADVANCED | |
| | Address | 880 | |
| | Function | This parameter selects the digital signal used to calculate the value of digital output **MDO2**.<br>It selects an analog variable used to calculate the value of digital input **MDO2** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P281 MDO2: Selecting Variable B

| P281 | Range | 0 ÷ 99 | See Table 30 |
|---|---|---|---|
| | Default | 51 | A51: Speed MEA |
| | Level | ADVANCED | |
| | Address | 881 | |
| | Function | This parameter selects the second digital signal used to calculate the value of digital output **MDO2**.<br>It selects an analog variable used to calculate the value of digital input **MDO2** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P282 MDO2: Testing Variable A

| P282 | Range | 0 ÷ 7 | 0: ><br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) ><br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
|---|---|---|---|
| | Default | 0 | 0: > |
| | Level | ADVANCED | |
| | Address | 882 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P280** using **P284** as a comparing value. | |

P283 MDO2: Testing Variable B

| P283 | Range | 0 ÷ 7 | 0: ><br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) ><br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
|---|---|---|---|
| | Default | 0 | 3: ≤ |
| | Level | ADVANCED | |
| | Address | 883 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P281** using **P285** as a comparing value. | |

P284 MDO2: Comparing Value for Test A

| P284 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable A,<br>See Table 30 |
|---|---|---|---|
| | Default | 2000 | 20% |
| | Level | ADVANCED | |
| | Address | 884 | |
| | Function | This parameter defines the comparing value with the selected variable for test A. | |

P285 MDO2: Comparing Value for Test B

| P285 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable B,<br>See Table 30 |
|---|---|---|---|
| | Default | 50 | 50 rpm |
| | Level | ADVANCED | |
| | Address | 885 | |
| | Function | This parameter defines the comparing value with the selected variable for test B. | |

P286 MDO2: Function Applied to the Result of the 2 Tests

| P286 | Range | 0 ÷ 5 | 0: (A) OR (B)<br>1: (A) SET (B) RESET<br>2: (A) AND (B)<br>3: (A) XOR (B)<br>4: (A) NOR (B)<br>5: (A) NAND (B) |
|---|---|---|---|
| | Default | 1 | 1: (A) SET (B) RESET |
| | Level | ADVANCED | |
| | Address | 886 | |
| | Function | This parameter determines the logic function applied to the result of the two tests to calculate the output value. | |

P287 MDO2: Output Logic Level

| P287 | Range | 0–1 | 0: FALSE<br>1: TRUE |
|---|---|---|---|
| | Default | 1 | 1: TRUE |
| | Level | ADVANCED | |
| | Address | 887 | |
| | Function | Digital output logic function MDO2 to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied. | |

P288 MDO3: Digital Output Mode

| P288 | Range | 0 ÷ 9 | 0: DISABLE<br>1: DIGITAL<br>2: DOUBLE DIGITAL<br>3: ANALOG<br>4: DOUBLE ANALOG<br>5: DOUBLE FULL<br>6: BRAKE<br>7: ABS BRAKE<br>8: ABS LIFT<br>9: PWM MODE |
|---|---|---|---|
| | Default | 1 | 1: DIGITAL |
| | Level | ADVANCED | |
| | Address | 888 | |
| | Function | This parameter defines the operating mode of **digital output 3**. The different operating modes are described in the previous section. | |

P289 MDO3: Selecting Variable A

| P289 | Range | 0 ÷ 99 | See Table 30 |
|---|---|---|---|
| | Default | 2 | D2: Inverter Ok On |
| | Level | ADVANCED | |
| | Address | 889 | |
| | Function | This parameter selects the digital signal used to calculate the value of digital output **MDO3**.<br>It selects an analog variable used to calculate the value of digital input **MDO3** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P290 MDO3: Selecting Variable B

| P290 | Range | 0 ÷ 99 | See Table 30 |
|---|---|---|---|
| | Default | 2 | D2: Inverter Ok On |
| | Level | ADVANCED | |
| | Address | 890 | |
| | Function | This parameter selects the second digital signal used to calculate the value of digital output **MDO3**.<br>It selects an analog variable used to calculate the value of digital input **MDO3** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P291 MDO3: Testing Variable A

| P291 | Range | 0 ÷ 7 | 0: ><br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) ><br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
|---|---|---|---|
| | Default | 0 | 0: > |
| | Level | ADVANCED | |
| | Address | 891 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P289** using **P293** as a comparing value. | |

P292 MDO3: Testing Variable B

| P292 | Range | 0 ÷ 7 | 0: >1: ≥2: <3: ≤4: ABS(x) >5: ABS(x) ≥6: ABS(x) <7: ABS(x) ≤ |
|---|---|---|---|
| | Default | 0 | 0: > |
| | Level | ADVANCED | |
| | Address | 892 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P290** using **P294** as a comparing value. | |

P293 MDO3: Comparing Value for Test A

| P293 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable A, see Table 30 |
|---|---|---|---|
| | Default | 0 | 0 |
| | Level | ADVANCED | |
| | Address | 893 | |
| | Function | This parameter defines the comparing value with the variable selected for test A. | |

P294 MDO3: Comparing Value for Test B

| P294 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable B, see Table 30 |
|---|---|---|---|
| | Default | 0 | 0 |
| | Level | ADVANCED | |
| | Address | 894 | |
| | Function | This parameter defines the comparing value with the variable selected for test B. | |

P295 MDO3: Function Applied to the Result of the 2 Tests

| P295 | Range | 0 ÷ 5 | 0: (A) OR (B)<br>1: (A) SET (B) RESET<br>2: (A) AND (B)<br>3: (A) XOR (B)<br>4: (A) NOR (B)<br>5: (A) NAND (B) |
|---|---|---|---|
| | Default | 0 | 0: (A) OR (B) |
| | Level | ADVANCED | |
| | Address | 895 | |
| | Function | This parameter determines the logic function applied to the result of the two tests to calculate the output value. | |

P296 MDO3: Output Logic Level

| P296 | Range | 0–1 | 0: FALSE<br>1: TRUE |
|---|---|---|---|
| | Default | 1 | 1: TRUE |
| | Level | ADVANCED | |
| | Address | 896 | |
| | Function | Digital output logic function MDO3 to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied. | |

P297 MDO4: Digital Output Mode

| | | | |
|---|---|---|---|
| P297 | Range | 0 ÷ 9 | 0: DISABLE<br>1: DIGITAL<br>2: DOUBLE DIGITAL<br>3: ANALOG<br>4: DOUBLE ANALOG<br>5: DOUBLE FULL<br>6: BRAKE<br>7: ABS BRAKE<br>8: ABS LIFT<br>9: PWM MODE |
| | Default | 1 | 1: DIGITAL |
| | Level | ADVANCED | |
| | Address | 897 | |
| | Function | This parameter defines the operating mode of **digital output 4**. The different operating modes are described in the section at the beginning of the chapter. | |

P298 MDO4: Selecting Variable A

| | | | |
|---|---|---|---|
| P298 | Range | 0 ÷ 99 | See Table 30 |
| | Default | 1 | D1: Inverter Run Ok |
| | Level | ADVANCED | |
| | Address | 898 | |
| | Function | This parameter selects the digital signal used to calculate the value of digital output **MDO4**.<br>It selects an analog variable used to calculate the value of digital input **MDO4** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P299 MDO4: Selecting Variable B

| | | | |
|---|---|---|---|
| P299 | Range | 0 ÷ 99 | See Table 30 |
| | Default | 1 | D1: Inverter Run Ok |
| | Level | ADVANCED | |
| | Address | 899 | |
| | Function | This parameter selects the second digital signal used to calculate the value of digital output **MDO4**.<br>It selects an analog variable used to calculate the value of digital input **MDO4** if one of the "analog" operating modes is selected.<br>Digital signals and analog variables are detailed in Table 30 | |

P300 MDO4: Testing Variable A

| | | | |
|---|---|---|---|
| P300 | Range | 0 ÷ 7 | 0: >=<br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) >=<br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
| | Default | 0 | 0: > |
| | Level | ADVANCED | |
| | Address | 900 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P298** using **P302** as a comparing value. | |

## P301 MDO4: Testing Variable B

| | | | |
|---|---|---|---|
| P301 | Range | 0 ÷ 7 | 0: ><br>1: ≥<br>2: <<br>3: ≤<br>4: ABS(x) ><br>5: ABS(x) ≥<br>6: ABS(x) <<br>7: ABS(x) ≤ |
| | Default | 0 | 0: > |
| | Level | ADVANCED | |
| | Address | 901 | |
| | Function | This parameter defines the test to be performed for the variable detected by **P299** using **P303** as a comparing value. | |

## P302 MDO4: Comparing Value for Test A

| | | | |
|---|---|---|---|
| P302 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable A, see Table 30 |
| | Default | 0 | 0 |
| | Level | ADVANCED | |
| | Address | 902 | |
| | Function | This parameter defines the comparing value with the selected variable for test A. | |

## P303 MDO4: Comparing Value for Test B

| | | | |
|---|---|---|---|
| P303 | Range | –32000 ÷ 32000 | –320.00 % ÷ 320.00 %<br>% of the full-scale value of selected variable B, see Table 30 |
| | Default | 0 | 0 |
| | Level | ADVANCED | |
| | Address | 903 | |
| | Function | This parameter defines the comparing value with the selected variable for test B. | |

## P304 MDO4: Function Applied to the Result of the 2 Tests

| | | | |
|---|---|---|---|
| P304 | Range | 0 ÷ 5 | 0: (A) OR (B)<br>1: (A) SET (B) RESET<br>2: (A) AND (B)<br>3: (A) XOR (B)<br>4: (A) NOR (B)<br>5: (A) NAND (B) |
| | Default | 0 | 0: (A) OR (B) |
| | Level | ADVANCED | |
| | Address | 904 | |
| | Function | This parameter determines the logic function applied to the result of the two tests to calculate the output value. | |

## P305 MDO4: Output Logic Level

| | | | |
|---|---|---|---|
| P305 | Range | 0–1 | 0: FALSE<br>1: TRUE |
| | Default | 1 | 1: TRUE |
| | Level | ADVANCED | |
| | Address | 905 | |
| | Function | Digital output logic function MDO4 to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied. | |

# 22. FIELD BUS PARAMETERS MENU

## 22.1. Overview

In this Menu it is possible to select the Third measure and the Fourth measure from the Field Bus.
The list of the selectable measures is the same as MEASURE MENU.
The First measure and the Second measure are fixed (Output Current and Motor Speed) (see EXCHANGED PARAMETERS).

## 22.2. List of Parameters from P330 to P331

Table 38: List of Parameters P330 ÷ P331

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| P330 | Third measure from the Field Bus | ENGINEERING | 930 | 12:Torque Out % |
| P331 | Fourth measure from the Field Bus | ENGINEERING | 931 | 22: PID Out% |

P330 Third measure from the Field Bus

| P330 | | | |
|---|---|---|---|
| | Range | 0-74 | M000-M074 |
| | Default | 12 | M012 :[Torque Out %] |
| | Level | ENGINEERING | |
| | Address | 930 | |
| | Function | Third measure exchanged via the Field Bus. | |

P331 Fourth measure from the Field Bus

| P331 | | | |
|---|---|---|---|
| | Range | 0-74 | M000-M074 |
| | Default | 22 | M022 :[PID Out %] |
| | Level | ENGINEERING | |
| | Address | 931 | |
| | Function | Fourth measure exchanged via the Field Bus. | |

# 23. AUTOTUNE MENU

## 23.1. Overview

NOTE See the chapter FIRST STARTUP for tuning based on the control algorithm to be used.

NOTE At the end of the Autotune procedure, the system automatically saves the whole parameter set of the inverter.

NOTE Autotune must be performed only after entering the motor ratings or the ratings of the encoder used as a speed feedback. Please refer to sections Motor Control Menu and Encoder/ Frequency Input Menu.

The selected motor may be tuned in order to obtain the machine ratings or the parameterization required for the correct functioning of the control algorithms. It is also possible to check the proper operation/wiring of the encoder used as a speed feedback.

The Autotune menu includes two programming parameters **I073** and **I074**. Parameter **I073** allows to enable and select the type of autotune. Parameter **I074**—which can be programmed only if **I073** = Motor Tune—describes the type of autotune carried out. Since the value of **I073** or **I074** can not be permanently changed and are automaticall reset following an autotune, the **ENABLE** signal must be disabled and the **ESC** key must be used to accept the set value.

### 23.1.1. MOTOR AUTOTUNE AND ADJUSTING LOOPS

Set **I073** as Motor Tune to enable autotune functions that can be selected with **I074**.

NOTE For the correct operation of the tuning algorithms, enter the motor ratings and the ratings of the encoder used as a speed feedback. Please refer to sections Motor Control Menu and Encoder Frequency Input Menu.

Table 39: Programmable "Motor Tune" Functions

| I074 Setup | Motor Rotation | Type of Tune |
|---|---|---|
| 0: all Auto no rotation | No | **Automatic** estimation of the stator resistance and the leakage inductance and calculation of the no-load current value and the rotor time constant value .<br>Tuning mode required for the correct operation of the control algorithms. |
| 1: FOC Auto no rotation | No | **Automatic** autotune of the current loop.<br>Tuning mode required for the correct operation of algorithm FOC.<br>If autotune of the current loop fails (Alarm **A065** Autotune KO trips), the current loop may be manually tuned (see 4: FOC Man rotation (current)). |
| 2: FOC Auto rotation | Yes | **Automatic** estimation of the rotor time constant.<br>Tuning mode required for the correct operation of algorithm FOC.<br>After the correct insertion of the no-load current value (parameters **C021**, **C064**, **C107** respectively for motors M1, M2 and M3) and the tuning of the current loop, it is possible to measure the rotor time constant value, for which the motor rotates up to 90% of the constant speed. |
| 3: VTC/FOC Man rotation (speed) | Yes | **Manual** tune of the current loop.<br>Display analog outputs AO1 and AO2, showing the speed reference and the speed value obtained with the preset parameters of the speed regulator (see the SPEED LOOP AND CURRENT BALANCING MENU). Set the regulator's parameters so as to obtain the smaller difference between the two waveforms. |
| 4: FOC Man rotation (current) | Yes | **Manual** tune of the current loop.<br>If automatic tuning 1: FOC Auto no rotation is unsuccessful, it is possible to manually tune the current loop. Display analog outputs AO1 and AO2, showing the current reference value and the current value measured. Set the current regulator's parameters (see FOC REGULATORS MENU) so as to obtain the smaller difference between the two waveforms. |
| 5: FOC Man rotation (flux) | Yes | **Manual** tune of the flux loop.<br>The correct parameters of the flux regulator are calculated whenever the rotor time constant value changes (see 2: FOC Auto rotation).<br>In any case, it is possible to manually tune the flux loop.<br>Display analog outputs AO1 and AO2, showing the flux reference value and the flux value obtained. Set the regulator's parameters so as to obtain the smaller difference between the two waveforms.<br>See the FOC REGULATORS MENU. |

**NOTE** If a **manual tune** is selected, do the following to quit the function: disable the **ENABLE** command and set **I073** = [ 0: Disable ]

### 23.1.2. CHECKING THE ENCODER OPERATION

Set I073 as Encoder Tune to check the correct operation of the encoder selected as a speed feedback (see the ENCODER/FREQUENCY INPUTS MENU) and to automatically set the correct rotation direction.

NOTE

Before checking the correct operation of the encoder used as a speed feedback, **enter the motor ratings and the encoder ratings.**
Please refer to the MOTOR CONTROL MENU and the ENCODER/FREQUENCY INPUTS MENU.

Once **I073** is set as Encoder Tune and the **ENABLE** and **START** commands are enabled, the connected motor attains a speed of rotation of approx. 150 rpm; its speed of rotation is detected by the encoder, then the inverter is disabled. The following messages can be displayed on the display/keypad:
**A059 Encoder Fault**
**W031 Encoder OK**

Then the following message is always displayed:
**W032 OPEN ENABLE**

If alarm **A059 Encoder Fault** trips: on the encoder input, the value measured by the inverter does not match with the real speed of rotation of the motor. Check that the encoder is properly set up (**Encoder/Frequency Input Menu**) and connected; if the Encoder B input is used, check the Configuration of the dip–switches located on optional board ES836 (see Sinus Penta Installation Instructions manual).
If **W031 Encoder OK** appears: speed feedback from encoder is correct.

In addition, the autotune sets the encoder signal as feedback with the parameter **C199**.

## 23.2. List of Parameters from I073 to I074

**Table 40: List of Parameters I073÷ I074**

| Parameter | FUNCTION | Access Level | MODBUS Address |
|---|---|---|---|
| I073 | Type of autotune | BASIC | 1460 |
| I074 | Type of motor tune | BASIC | 1461 |

**I073 Type of AutoTune**

| I073 | | | |
|---|---|---|---|
| | Range | 0 ÷ 2 | 0: Disable<br>1: Motor Tune<br>2: Encoder Tune |
| | Default | *This is not a programming parameter: the input is set to zero whenever the inverter is powered on and whenever the command is executed.* | |
| | Level | BASIC | |
| | Address | 1460 | |
| | Function | **I073** selects the type of tune to perform.<br>If you select [1: Motor Tune]: **I074** sets different types of tune for current loops, flux loops and speed loops and for the estimation of the motor ratings (see section 23.1.1).<br>If you select [2: Encoder Tune]: you can check the correct operation of the encoder used as a speed feedback (see section 23.1.2). | |

## I074 Type of Motor Tune

| | | | |
|---|---|---|---|
| I074 | Range | 0 ÷ 5 | 0: All Auto no rotation<br>1: FOC Auto no rotation<br>2: FOC Auto rotation<br>3: VTC/FOC Man rotation (speed)<br>4: FOC Man rotation (current)<br>5: FOC Man rotation (flux) |
| | Default | *This is not a programming parameter: the input is set to zero whenever the inverter is powered on and whenever the command is executed.* | |
| | Level | BASIC | |
| | Address | 1461 | |
| | Function | **I074** selects the type of autotune to perform if **I073** = [1: Motor Tune] (see section 23.1.1). | |

NOTE

No changes can be made to **I073** and **I074** with the **ENABLE** signal present. If an attempt to change these values is made with **ENABLE** active, **"W34 ILLEGAL DATA"** warning is given. Remove the **ENABLE** signal to set these values and activate the **ENABLE** signal to begin the selected autotune process.

NOTE

If **SAVE/ENTER** is pressed to store the changes to **I073** and **I074**, **"W17 SAVE IMPOSSIBLE"** warning will be displayed. Use **ESC** key instead.

# 24. CARRIER FREQUENCY MENU

## 24.1. Overview

The Carrier Frequency Menu sets some of the PWM modulation characteristics based on the preset type of control.

### 24.1.1. IFD CONTROL

The IFD control allows to gain access to all the parameters included in the Carrier Frequency menu.
The user can set the minimum value and the maximum value of the switching carrier frequency and the number of pulses per period used to produce the output frequency when switching from min. carrier frequency to max. carrier frequency (synchronous modulation). The preset max. value of carrier frequency also limits the max. allowable speed value for the selected motor, which can be programmed according to the following rules:
**Max. allowable speed → rated speed * (max. output frequency/rated frequency)**
where the max. output frequency is given by:
**C002** > 5000Hz fout_max = **C002** / 16
**C002** ≤ 5000Hz fout_max = **C002** / 10

where **C002** is the maximum carrier frequency and the divider is the minimum number of pulses guaranteed per period.

**Table 41: Max. Output Frequency Depending on the Inverter Size**

| Size | Max. Output Frequency (Hz) |
|---|---|
| less than 0049 | 1000 |
| from 0049 to 0086 | 8000 |
| from 0113 to 0129 | 625 |
| from 0150 to 0162 | 500 |
| greater than 0162 | 400 |

The silent modulation function can also be enabled.

## 24.1.2. EXAMPLE (IFD)

Setting two levels of carrier frequency and the number of pulses used for synchronous modulation.
A lower value for carrier frequency ensures a better performance of the motor but implies higher noise levels. Suppose that the connected motor has a rated speed equal to 1500rpm at 50Hz and that you need the best performance up to 200rpm and a "noiseless" carrier frequency at max. speed (3000rpm).
In this case, the max. speed of the inverter will produce an output voltage with a frequency value equal to 100Hz; in proximity to this speed the carrier frequency should be at its maximum level. Suppose that a model having a max. carrier frequency of 16kHz is used.
Assign the following:
**C001** = 1600Hz
**C002** = 16000Hz
**C003** ≥ (**C002**/100Hz) = (160 pulses per period)

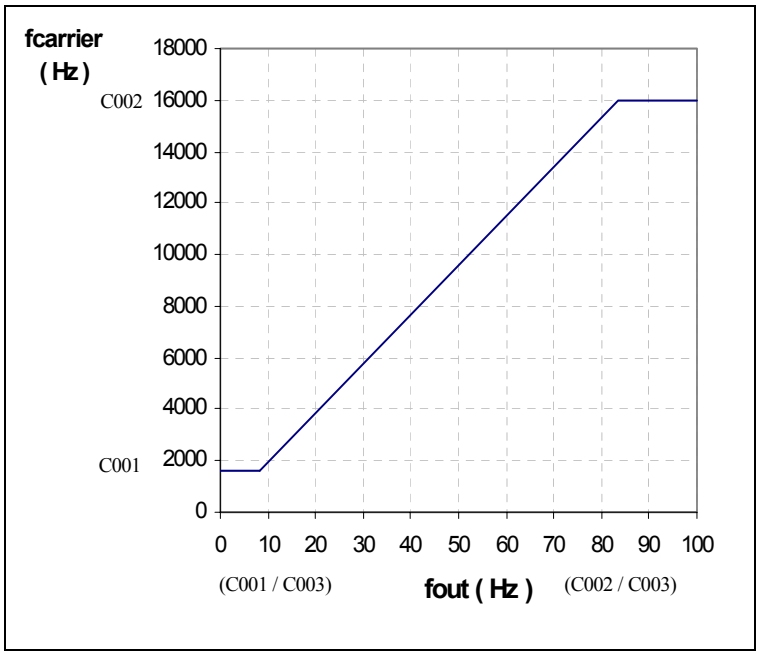



Figure 31: Carrier Frequency (Example)

Suppose that we configure **C003** = 192np, so that **C002**/**C003** = 16000/192 = 83.33Hz. The max. carrier frequency is obtained with this output frequency. The min. frequency is kept constant until frequency **C001**/**C003** = 8.33 Hz is attained, corresponding to 250 rpm of the motor speed. In the output frequency range, ranging from 8.33 to 83.33Hz, a synchronous modulation is obtained and the carrier frequency applied results from: f carrier = fout * **C003** [Hz].

### 24.1.3. VTC CONTROL

The only parameter of the Carrier Frequency menu used for VTC control algorithm is **C004**, allowing to enable silent modulation. The modulation frequency to be used is defined by the inverter.

### 24.1.4. FOC CONTROL

FOC control algorithm selects the silent modulation mode (**C004**) and allows to increase carrier frequency when possible. FOC algorithm uses a carrier frequency corresponding to:

Min [8kHz ; Max. carrier freq. allowed for the inverter size];

In **C002**, if you set a higher value than the value resulting from the formula above, FOC control will use **C002** as the modulation frequency.

## 24.2. List of Parameters from C001 to C004

Table 42: List of Parameters C001 ÷ C004

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C001 | Minimum carrier frequency | ENGINEERING | 1001 | Table 43 |
| C002 | Maximum carrier frequency | ENGINEERING | 1002 | Table 43 |
| C003 | Number of pulses | ENGINEERING | 1003 | 1: (24) |
| C004 | Silent modulation | ENGINEERING | 1004 | 1: (Yes) |

The default values of carrier frequency C001 and C002 and their max. values depend on the inverter size.

Table 43: Default Values and Max. Values of the Carrier Frequency Depending on the Inverter Size

| SIZE | MODEL | C001/2 Carrier Default [kHz] | Carrier Max.[kHz] |
|---|---|---|---|
| S05 | 0005 | 5 | 16 |
| | 0007 | 5 | 16 |
| | 0009 | 5 | 16 |
| | 0011 | 5 | 16 |
| | 0014 | 5 | 16 |
| S10 | 0016 | 5 | 16 |
| | 0017 | 5 | 16 |
| | 0020 | 5 | 16 |
| | 0025 | 3 | 16 |
| | 0030 | 3 | 16 |
| | 0035 | 3 | 16 |
| S15 | 0038 | 5 | 16 |
| | 0040 | 5 | 16 |
| | 0049 | 5 | 12.8 |
| S20 | 0060 | 5 | 12.8 |
| | 0067 | 5 | 12.8 |
| | 0072 | 5 | 12.8 |
| | 0086 | 5 | 12.8 |
| S30 | 0113 | 3 | 10 |
| | 0129 | 3 | 10 |
| | 0150 | 3 | 5 |
| | 0162 | 3 | 5 |
| S40 | 0179 | 2 | 4 |
| | 0200 | 2 | 4 |
| | 0216 | 2 | 4 |
| S40/S65 | 0250 | 2 | 4 |
| S50/S65 | 0312 | 2 | 4 |
| | 0366 | 2 | 4 |
| | 0399 | 2 | 4 |
| S60/S65 | 0457 | 2 | 4 |
| | 0524 | 2 | 4 |
| S65 | 0598 | 2 | 4 |
| | 0748 | 2 | 4 |
| S65/S70 | 0831 | 2 | 4 |

## C001 Minimum Carrier Frequency

| C001 | | | |
|---|---|---|---|
| | Range | 800 -16000 Depending on the inverter model | 800 – 16000 Hz<br>Depending on the inverter model – see Table 43 |
| | Default | Depending on the inverter model | Table 43 |
| | Level | ENGINEERING | |
| | Addr | 1001 | |
| | Control | IFD | |
| | Function | It represents the min. value of the modulation frequency being used. | |

NOTE

The min. value set in **C001** cannot exceed the max. value set in **C002**. Increase the max. value in **C002** if you need to increase the min. value and if **C001** equals **C002**.

## C002 Maximum Carrier Frequency

| C002 | | | |
|---|---|---|---|
| | Range | 800 -16000 Depending on the inverter size | 800 – 16000 Hz<br>Depending on the inverter size – see Table 43 |
| | Default | Depending on the inverter size | Table 43 |
| | Level | ENGINEERING | |
| | Addr | 1002 | |
| | Control | IFD and FOC | |
| | Function | It represents the max. value of the modulation frequency being used. As per FOC control, the modulation frequency set in C002 is used only if it exceeds the modulation frequency resulting from the following formula:<br>Min. [ 8kHz ; Max. carrier freq. allowed for the inverter size];<br>Example:<br>Max. carrier freq. allowed: 10kHz<br>If **C002** = 5kHz for FOC control; modulation frequency is 8kHz.<br>If **C002** = 10kHz for FOC control; modulation frequency is 10kHz. | |

NOTE

The max. value set in **C002** cannot be lower than the min. value set in **C001**. Decrease the min. value in C001 if you need to decrease the max. value and if **C001** equals **C002**.

NOTE

**IFD Control only:** The max. value in **C002** also determines the max. allowable speed value for the selected motor, in order to ensure a minimum number of pulses per period of frequency produced, 16 for maximum carrier frequency (max. **C002** value) greater than 5kHz and 10 for lower maximum carrier frequency

**(see Table 43)**

## C003 Pulse Number

| C003 | | | |
|---|---|---|---|
| | Range | 0-5 | 0: [12] 1: [24]<br>2: [48] 3: [96]<br>4: [192] 5: [384] |
| | Default | 1 | 1: [24] |
| | Level | ENGINEERING | |
| | Addr | 1003 | |
| | Control | IFD | |
| | Function | This parameter has effect only if **C001≠C002**. It represents the min. value of pulses per period obtained when modulation frequency changes (synchronous modulation). | |

C004 Silent Modulation

| C004 | | | |
|---|---|---|---|
| | Range | 0-1 | 0: [No]; 1: [Yes] |
| | Default | 1 | 1: [Yes] |
| | Level | ENGINEERING | |
| | Addr | 1004 | |
| | F | This parameter enables silent modulation. The electric noise due to the commutation frequency is dampened. | |

# 25. MOTOR CONTROL MENU

## 25.1. Overview

The Sinus Penta allows to configure three different types of motors and three different types of control algorithms at the same time.

The three types of control algorithms are identified with the acronyms
- ✓ **IFD** (Voltage/Frequency Control);
- ✓ **VTC** (Vector Torque Control);
- ✓ **FOC** (Field Oriented Control).

Voltage/Frequency control allows to control the motor by producing voltage depending on frequency.
Vector Torque Control (sensorless) processing the machine equations depending on the equivalent parameters of the asynchronous machine allows to separate torque control from flux control with no need to use a transducer.
Field Oriented Control is a closed-chain control requiring a speed transducer to detect the position of the motor shaft instant by instant.

The parameter set for the selected motor is included in the Motor Control menu:
- ✓ Motor Control 1 Menu concerns motor 1;
- ✓ Motor Control 2 Menu concerns motor 2;
- ✓ Motor Control 3 Menu concerns motor 3.

Factory setting allows to configure one motor only. To gain access to the Configuration menus of the other connected motors, simply enter the number of the selected motor in **C009** (Number of Configured Motors) in the Motor Control 1 Menu.
To select the connected motor, use digital inputs programmed with parameters **C173** and **C174**, Digital Input for Motor 2 Activation and Digital Input for Motor 3 Activation respectively (see also DIGITAL INPUTS MENU).
The parameters included in the Motor Control Menus are detailed in the table below.

**Table 44: Description of the Parameters Classified by Motor**

| Parameter Contents | Motor Control 1 | Motor Control 2 | Motor Control 3 |
|---|---|---|---|
| Mains rated voltage | C008 | ———————— | ———————— |
| Control algorithm being used | C010 | C053 | C096 |
| Type of reference being used (speed/torque) | C011 | C054 | C097 |
| Availability of the speed feedback from encoder | C012 | C055 | C098 |
| Electric ratings of the motor | C015 ÷ C025 | C058 ÷ C068 | C101 ÷ C111 |
| Max. speed and min. speed required, speed at the beginning of flux weakening, max. speed alarm threshold and enabling | C028 ÷ C031 | C071 ÷ C074 | C114 ÷ C117 |
| V/f pattern parameters | C013/C032 ÷ C038 | C056/C075 ÷ C081 | C099/C118 ÷ C124 |
| Slip compensation activation | C039 | C082 | C125 |
| Drop in rated current voltage | C040 | C083 | C126 |
| Fluxing ramp time | C041 | C084 | C127 |

The parameters that can be modified depend on the type of control that has been selected.

### 25.1.1. ELECTRICAL SPECIFICATIONS OF THE MOTOR

This group of parameters can be divided into two subunits: the first subunit includes the motor ratings, the second subunit includes the parameters of the equivalent circuit of the asynchronous machine being used.

### 25.1.2. MOTOR RATINGS

Table 45: Motor Ratings

| Motor Ratings | Motor 1 | Motor 2 | Motor 3 |
|---|---|---|---|
| Rated frequency | C015 | C058 | C101 |
| Rated rpm | C016 | C059 | C102 |
| Rated power | C017 | C060 | C103 |
| Rated current | C018 | C061 | C104 |
| Rated voltage | C019 | C062 | C105 |
| No-load power | C020 | C063 | C106 |
| No-load current | C021 | C064 | C107 |

### 25.1.3. PARAMETERS OF THE EQUIVALENT CIRCUIT OF THE ASYNCHRONOUS MACHINE

Table 46: Parameters of the Equivalent Circuit of the Asynchronous Machine

| Description | Motor 1 | Motor 2 | Motor 3 |
|---|---|---|---|
| Stator resistance | C022 | C065 | C108 |
| Leakage inductance | C023 | C066 | C109 |
| Mutual inductance | C024 | C067 | C110 |
| Rotor time constant | C025 | C068 | C111 |

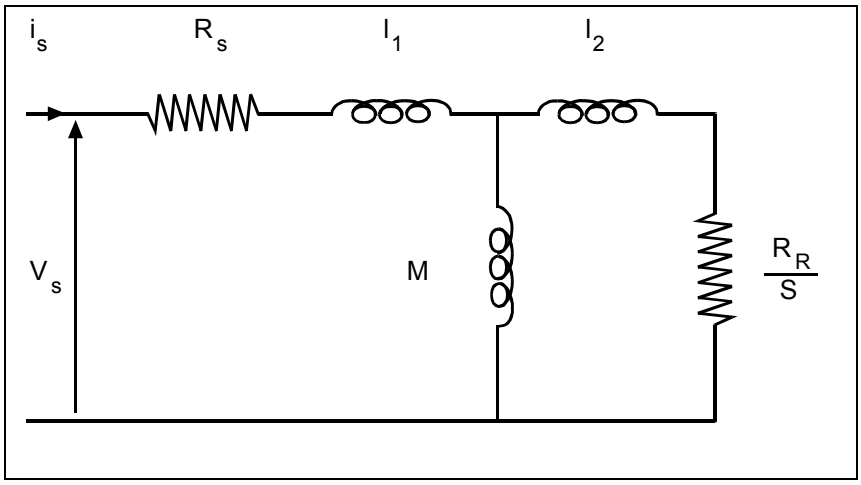



Figure 32: Equivalent Circuit of the Asynchronous Machine

Where:
Rs: Stator resistance (wires included)
Rr: Rotor resistance
$l_1+l_2$: Full leakage inductance
M: Mutual inductance (not required for motor activation)
S: Slip
$\tau$ rot. $\cong$ M / Rr rotor time constant.

Because the motor characteristics are generally unknown, the Sinus Penta is capable of automatically determining the motor characteristics (see FIRST STARTUP and AUTOTUNE MENU).
In any case, some parameters may be manually adjusted to meet the requirements of special applications.

The parameters used for the different control algorithms are stated in the table below.

**Table 47: Motor Parameters Used by Control Algorithms**

| Parameter | IFD | VTC | FOC |
|---|---|---|---|
| Stator resistance | ■ | ■ | ■ |
| Leakage inductance | — | ■ | — |
| Mutual inductance | — | — | ■ |
| Rotor time constant | — | — | ■ |

■ Used ; — Not used

NOTE Because the value of the stator resistance is used for any type of control, always perform the autotune procedure with **I073**= Motor Tune and **I074**= 0: All no rotation.

## 25.1.4. V/F PATTERN (IFD ONLY)

This group of parameters which is included in the **Motor Control Menu** defines the V/f pattern trend of the inverter when it is used as an IFD control algorithm. By programming the parameter type of the V curve on f (e.g. **C013** for motor 1) it is possible to adopt the following curves:

- Constant torque
- Quadratic
- Free setting

The diagram below illustrates three types of programmable curves compared to the theoretical V/f curve.
By setting **C013 = Constant Torque,** with respect to the theoretical curve it is possible to alter the voltage starting value (to compensate for losses caused by stator impedance and for more torque at lower revs) using the preboost parameter **C034**.
By setting **C013 = Quadratic,** the inverter will follow a V/f pattern with a parabolic trend for which it is possible to set the voltage starting value (**C034**) , the desired reduction in voltage compared to the relative constant torque with **C032** and the frequency on which the actuate this torque reduction with **C033**.
By setting **C013 = Free Setting** it is possible to program the starting voltage (**C034 Preboost**), the increase in voltage to 1/20 of the rated frequency (**C035 Boost0**), and the increase in voltage (**C036 Boost1**) to the programmable frequency (**C037 Frequency for Boost1**).

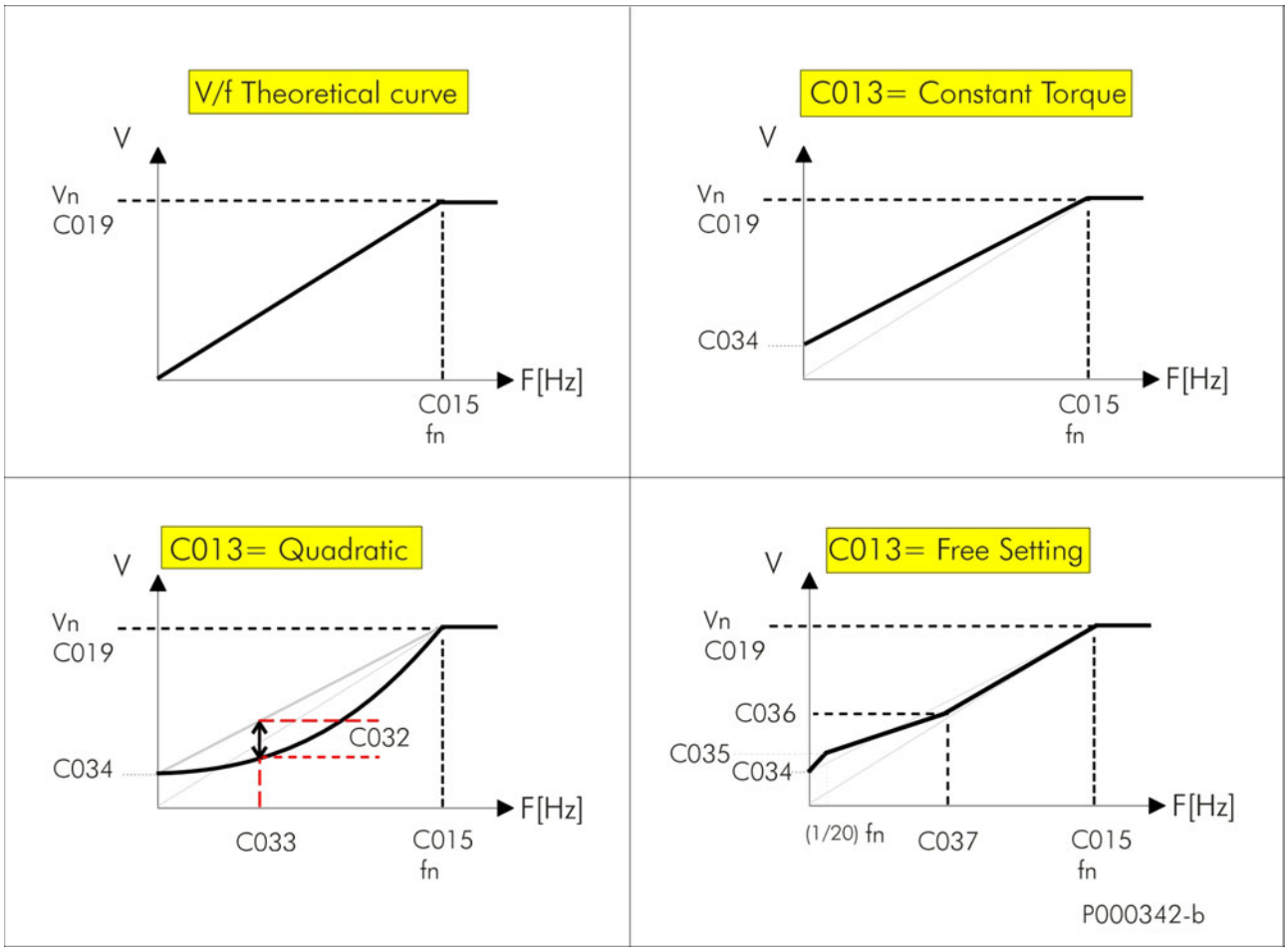



Figure 33: Types of programmable V/f curves

The voltage produced by the inverter may be altered also by setting the parameter **Automatic Increase torque curve** (**C038 for motor 1**).

For the description of the parameters used in the figure, see table below.

Table 48: IFD Control Parameters for the Connected Motors

| Parameter | Motor 1 | Motor 2 | Motor 3 |
|---|---|---|---|
| **Rated frequency:** rated frequency of the connected motor (current rating). | C015 | C058 | C101 |
| **Rated voltage:** rated voltage of the connected motor (voltage rating). | C019 | C062 | C105 |
| **V/f curve type:** Type of V/f curve applied | C013 | C056 | C099 |
| **Torque reduction quadratic curve:** Torque reduction using V/f quadratic curve | C032 | C075 | C118 |
| **Rated speed referring to torque reduction quadratic curve:** Speed that actuates the torque reduction using quadratic curve | C033 | C076 | C119 |
| **Voltage preboost:** determines the voltage produced by the inverter at min. output frequency fomin. | C034 | C077 | C120 |
| **Voltage boost 0 of torque curve:** determines the variation of the output rated voltage at fnom/20; Boost >0 increases the starting torque. | C035 | C078 | C121 |
| **Voltage boost 1 of torque curve:** determines the voltage variation with respect to rated voltage at preset frequency. | C036 | C079 | C122 |
| **Frequency for the application of Boost 1:** determines the frequency for the application of the boost at preset frequency. | C037 | C080 | C123 |
| **Automatic increase torque curve:** variable torque compensation expressed as a percentage of the motor rated voltage. The preset value expresses the voltage increase when the motor is running at rated torque. | C038 | C081 | C124 |

### 25.1.5. EXAMPLE 1 V/F PATTERN PARAMETRIZATION

Motor 1: voltage/frequency pattern is to be programmed for an asynchronous motor (400V/50Hz) with a rated speed of 1500rpm up to 2000rpm.

| | | | |
|---|---|---|---|
| Type of V/f curve | C013 | = | Constant Torque |
| Rated frequency | C015 | = | 50 Hz |
| Rated voltage | C019 | = | 400 V |
| Preboost | C034 | = | depending on the starting torque |
| Max. speed | C115 | = | 2000rpm |

### 25.1.6. EXAMPLE 2 V/F PATTERN PARAMETRIZATION

Voltage/frequency pattern is to be programmed for an asynchronous motor (400V/50Hz) having a rated power of 7.5 kW and a rated speed of 1420 rpm with a voltage compensation depending on the motor torque. Voltage compensation (AutoBoost) is calculated as follows:

| | | | |
|---|---|---|---|
| Type of V/f curve | C013 | = | Constant Torque |
| Rated frequency | C015 | = | 50 Hz |
| Motor rpm | C016 | = | 1420rpm |
| Rated power | C017 | = | 7.5kW |
| Rated voltage | C019 | = | 400 V |
| Preboost | C034 | = | depending on the starting torque |
| Autoboost | C038 | = | 4% |

Voltage compensation (AutoBoost) results from the formula below:
$\Delta V$ = **C019** x (**C038**/100) x (T/Tn)
Where T is the estimated motor torque and Tn is the motor rated torque.
Tn is calculated as follows:
Tn = (Pn x pole torques/$2\pi f$ = (**C017** x pole torques)/($2\pi$ x **C015**)
Where pole torques is the integer number obtained by approximating (60* **C015**/**C016**) by defect.

The programmable parameters relating to the AutoBoost functions are the following:
**C038** (AutoBoost): variable torque compensation expressed as a percentage of the motor rated voltage (**C019**). The value set in **C038** is the voltage increase when the motor is running at its rated torque.
**C017** (Pn): rated power of the connected motor.

## 25.1.7. SLIP COMPENSATION (IFD ONLY)

This function allows to compensate the speed decrease of the asynchronous motor when the mechanical load increases (slip compensation), only for the IFD control.
Parameters relating to this function are included in the Motor Control Menu (Configuration Menu).

**Table 49: Parameters for Slip Compensation, IFD Control**

| Parameter | Motor 1 | Motor 2 | Motor 3 |
|---|---|---|---|
| **Rated voltage:**<br>rated voltage of the connected motor (voltage rating). | C019 | C062 | C105 |
| **No-load power:**<br>Power absorbed by the motor when no load is connected to the motor; it is expressed as a percentage of the motor rated power. | C020 | C063 | C106 |
| **Stator resistance:**<br>determines the resistance of the stator phases used to compute the power consumption due to Joule effect. | C022 | C065 | C108 |
| **Activation of slip compensation:**<br>If other than zero, this parameter enables slip compensation and defines its relevant value. | C039 | C082 | C125 |

Once the inverter power output has been estimated and the power losses due to the Joule effect and to the mechanical parts (function of output voltage and no-load power) have been subtracted, mechanical power is obtained. Starting from mechanical power and the value set for slip compensation (**C039** for motor 1), you can obtain the increase of the output frequency limiting the error between the desired speed value and the actual speed value of the motor.

## 25.1.8. TORQUE CONTROL (VTC AND FOC ONLY)

VTC and FOC controls allow to control the inverter with a torque reference instead of a speed reference. To do so, select VTC or FOC and set [1: Torque] in the relevant parameter (**C011** for motor 1, **C054** for motor 2, and **C097** for motor 3).
In this way, the main reference corresponds to the motor torque demand and may range from **C047** to **C048** (**Limits Menu**) for motor 1 (minimum and maximum torque expressed as a percentage of the motor rated torque). For motors 2 and 3, the parameters relating to min. and max. torque (**C090**, **C091** and **C133**, **C134**) are included in Limits Menu 2 and Limits Menu 3.
Using a 0020 inverter connected to a 15kW motor, **C048** is factory-set to 120% of the motor rated torque. If the max. reference is applied (**C143** = REF), the torque reference will be equal to 120%.
If a 7.5kW motor is connected, **C048** may exceed 200%; torques exceeding 200% may be obtained based on the value set in **C048**.
The motor rated torque results from the following formula:
$C=P/\omega$
where P is the rated power expressed in W and $\omega$ is the rated speed of rotation expressed in radiants/sec.
Example: the rated torque of a 15kW motor at 1420rpm is equal to:

$$C = \frac{15000}{1420 \cdot 2\pi/60} = 100.9 \text{ Nm}$$

The starting torque is:
rated torque * 120% = 121.1 Nm

## 25.2. List of Parameters from C008 to C128

Table 50: List of Parameters C008 ÷ C128

| Parameter | | FUNCTION | Access Level | Default Value | MODBUS Address |
|---|---|---|---|---|---|
| C008 | | Mains rated voltage | BASIC | 2:[380;480]V | 1008 |
| C009 | | Number of configured motors | ENGINEERING | 1 | 1009 |
| C010 | M1 | Type of control algorithm | BASIC | 0:IFD | 1010 |
| C053 | M2 | | BASIC | 0:IFD | 1053 |
| C096 | M3 | | BASIC | 0:IFD | 1096 |
| C011 | M1 | Type of reference | ADVANCED | 0: Speed (MASTER mode) | 1011 |
| C054 | M2 | | ADVANCED | 0: Speed (MASTER mode) | 1054 |
| C097 | M3 | | ADVANCED | 0: Speed (MASTER mode) | 1097 |
| C012 | M1 | Speed feedback from encoder | BASIC | 0; NO | 1012 |
| C055 | M2 | | BASIC | 0; NO | 1055 |
| C098 | M3 | | BASIC | 0; NO | 1098 |
| C013 | M1 | Type of V/f curve | BASIC | 0: (Constant Torque) | 1013 |
| C056 | M2 | | BASIC | 0: (Constant Torque) | 1056 |
| C099 | M3 | | BASIC | 0: (Constant Torque) | 1099 |
| C015 | M1 | Motor rated frequency | BASIC | 50.0 Hz | 1015 |
| C058 | M2 | | BASIC | 50.0 Hz | 1058 |
| C101 | M3 | | BASIC | 50.0 Hz | 1101 |
| C016 | M1 | Motor rated rpm | BASIC | 1420 rpm | 1016 |
| C059 | M2 | | BASIC | 1420 rpm | 1059 |
| C102 | M3 | | BASIC | 1420 rpm | 1102 |
| C017 | M1 | Motor rated power | BASIC | See Table 53 | 1017 |
| C060 | M2 | | BASIC | See Table 53 | 1060 |
| C103 | M3 | | BASIC | See Table 53 | 1103 |
| C018 | M1 | Motor rated current | BASIC | See Table 52 | 1018 |
| C061 | M2 | | BASIC | See Table 52 | 1061 |
| C104 | M3 | | BASIC | See Table 52 | 1104 |
| C019 | M1 | Motor rated voltage | BASIC | 5.0 ÷ 1200.0 V | 1019 |
| C062 | M2 | | BASIC | 5.0 ÷ 1200.0 V | 1062 |
| C105 | M3 | | BASIC | 5.0 ÷ 1200.0 V | 1105 |
| C020 | M1 | Motor no-load power | ADVANCED | 0.0% | 1020 |
| C063 | M2 | | ADVANCED | 0.0% | 1063 |
| C106 | M3 | | ADVANCED | 0.0% | 1106 |
| C021 | M1 | Motor no-load current | ADVANCED | 0.0% | 1021 |
| C064 | M2 | | ADVANCED | 0.0% | 1064 |
| C107 | M3 | | ADVANCED | 0.0% | 1107 |
| C022 | M1 | Motor stator resistance | ENGINEERING | See Table 52 | 1022 |
| C065 | M2 | | ENGINEERING | See Table 52 | 1065 |
| C108 | M3 | | ENGINEERING | See Table 52 | 1108 |
| C023 | M1 | Leakage inductance | ENGINEERING | See Table 52 | 1023 |
| C066 | M2 | | ENGINEERING | See Table 52 | 1066 |
| C109 | M3 | | ENGINEERING | See Table 52 | 1109 |
| C024 | M1 | Mutual inductance | ADVANCED | See Table 52 | 1024 |
| C067 | M2 | | ADVANCED | See Table 52 | 1067 |
| C110 | M3 | | ADVANCED | See Table 52 | 1110 |
| C025 | M1 | Rotor time constant | ADVANCED | See Table 52 | 1025 |
| C068 | M2 | | ADVANCED | See Table 52 | 1068 |
| C111 | M3 | | ADVANCED | See Table 52 | 1111 |

| | | | | | |
|---|---|---|---|---|---|
| C028 | M1 | Motor min. speed | BASIC | 0 rpm | 1028 |
| C071 | M2 | | BASIC | 0 rpm | 1071 |
| C114 | M3 | | BASIC | 0 rpm | 1114 |
| C029 | M1 | Motor max. speed | BASIC | 1500 rpm | 1029 |
| C072 | M2 | | BASIC | 1500 rpm | 1072 |
| C115 | M3 | | BASIC | 1500 rpm | 1115 |
| C030 | M1 | Flux weakening speed | ENGINEERING | 90% | 1030 |
| C073 | M2 | | ENGINEERING | 90% | 1073 |
| C116 | M3 | | ENGINEERING | 90% | 1116 |
| C031 | M1 | Max. speed alarm | ADVANCED | 0: (Disabled) | 1031 |
| C074 | M2 | | ADVANCED | 0: (Disabled) | 1074 |
| C117 | M3 | | ADVANCED | 0: (Disabled) | 1117 |
| C032 | M1 | Reduction in quadratic torque curve | ADVANCED | 30% | 1032 |
| C075 | M2 | | ADVANCED | 30% | 1075 |
| C118 | M3 | | ADVANCED | 30% | 1118 |
| C033 | M1 | Rated revs referring to reduction in quadratic torque curve | ADVANCED | 20% | 1033 |
| C076 | M2 | | ADVANCED | 20% | 1076 |
| C119 | M3 | | ADVANCED | 20% | 1119 |
| C034 | M1 | Voltage Preboost | ADVANCED | See Table 52 | 1034 |
| C077 | M2 | | ADVANCED | See Table 52 | 1077 |
| C120 | M3 | | ADVANCED | See Table 52 | 1120 |
| C035 | M1 | Voltage Boost at 5% of the motor rated frequency | ADVANCED | 0% | 1035 |
| C078 | M2 | | ADVANCED | 0% | 1078 |
| C121 | M3 | | ADVANCED | 0% | 1121 |
| C036 | M1 | Voltage Boost at programmable frequency | ADVANCED | 0% | 1036 |
| C079 | M2 | | ADVANCED | 0% | 1079 |
| C122 | M3 | | ADVANCED | 0% | 1122 |
| C037 | M1 | Frequency for application of voltage Boost at programmable frequency | ADVANCED | 50% | 1037 |
| C080 | M2 | | ADVANCED | 50% | 1080 |
| C123 | M3 | | ADVANCED | 50% | 1123 |
| C038 | M1 | Autoboost | BASIC | 1% | 1038 |
| C081 | M2 | | BASIC | 1% | 1081 |
| C124 | M3 | | BASIC | 1% | 1124 |
| C039 | M1 | Slip compensation | ADVANCED | 0: Disabled | 1039 |
| C082 | M2 | | ADVANCED | 0: Disabled | 1082 |
| C125 | M3 | | ADVANCED | 0: Disabled | 1125 |
| C040 | M1 | Decrease in voltage at rated current | ADVANCED | 0: Disabled | 1040 |
| C083 | M2 | | ADVANCED | 0: Disabled | 1083 |
| C126 | M3 | | ADVANCED | 0: Disabled | 1126 |
| C041 | M1 | Fluxing ramp time | ENGINEERING | See Table 52 | 1041 |
| C084 | M2 | | ENGINEERING | See Table 52 | 1084 |
| C127 | M3 | | ENGINEERING | See Table 52 | 1127 |

C008 Mains Rated Voltage

| | | | |
|---|---|---|---|
| C008 | Range | 0 ÷ 8 | 0: [ 200 ÷ 240 ] V<br>1: 2T Regen.<br>2: [ 380 ÷ 480 ] V<br>3: [ 481 ÷ 500 ] V<br>4: 4T Regen.<br>5: [ 500 ÷ 575 ] V<br>6: 5T Regen.<br>7: [ 575 ÷ 690 ] V<br>8: 6T Regen. |
| | Default | 2 | 2: [ 380 ÷ 480 ] V |
| | Level | BASIC | |
| | Address | 1008 | |
| | Function | This parameter defines the rated voltage of the mains powering the inverter, thus allowing to obtain voltage ranges to be used for the inverter operation. The setting of this parameter depends on the **Inverter voltage class.**<br>To supply the inverter with a not stabilized DC source, it is necessary to use the equivalent AC voltage range (see table 50 below). DO NOT USE xT Regen settings in this case. | |

| AC Mains | DC range |
|---|---|
| 200÷240 Vac | 280÷360 Vdc |
| 380÷480 Vac | 530÷678 Vdc |
| 481÷500 Vac | 680÷705 Vdc |
| 500÷575 Vac | 705÷810 Vdc |
| 575÷690 Vac | 810÷970 Vdc |

**Table 51: Equivalence between AC mains range and DC range**

NOTE

If the inverter is DC powered through a regenerative Sinus Penta or other drive for stabilizing the DC bus, select xT Regen (where x relates to the inverter voltage class).

C009 Number of Configured Motors

| | | | |
|---|---|---|---|
| C009 | Range | 1 ÷ 3 | 1 ÷ 3 |
| | Default | 1 | 1 |
| | Level | ENGINEERING | |
| | Address | 1009 | |
| | Function | This parameter determines the number of motors to be configured. The active motor is selected through digital inputs programmed with **C173** and **C174** (see DIGITAL INPUTS MENU).<br>The programming parameters of the Motor Control 2 Menu can be accessed only if **C009** = 2 or 3; the programming parameters of the Motor Control 3 Menu can be accessed only if **C009** =3. | |

## C010 (C053,C096) Type of Control Algorithm

| | | | |
|---|---|---|---|
| C010 (motor 1)<br>C053 (motor 2)<br>C096 (motor 3) | Range | *0 ÷ 2* | *0: IFD*<br>*1: VTC*<br>*2: FOC* |
| | Default | 0 | 0: IFD |
| | Level | BASIC | |
| | Address | 1010<br>1053<br>1096 | |
| | Function | This parameter sets the type of control algorithm to be used.<br>Type of controls:<br>0: IFD — V/f control<br>1: VTC — Sensorless Vector Torque control<br>2: FOC — Field Oriented Control<br>**V/f control** allows to control the motor by producing voltage depending on frequency. It is possible to configure several types of V/f patterns (see V/f Pattern (IFD Only)).<br>**Sensorless vector control** processing the machine equations depending on the equivalent parameters of the asynchronous machine as stator resistance and leakage inductance (**C022**, **C023** for motor 1; **C065**, **C066** for motor 2; **C108**, **C109** for motor 3) allows to separate torque control from flux control with no need to use a transducer; the inverter can be then controlled with a torque reference instead of a speed reference.<br>**Field oriented control** is a closed-loop control requiring a speed transducer to detect the position of the motor shaft instant by instant. The machine equations depend on the following:<br>magnetizing current, obtained from no-load current **C021** (**C064** for motor 2 and **C107** for motor 3); mutual inductance **C024** (**C067** for motor 2 and **C110** for motor 3); rotor time constant **C025** (**C068** for motor 2 and **C111** for motor 3).<br>The machine equations allow to separate torque control from flux control with no need to use a transducer; the inverter can be controlled with a torque reference instead of a speed reference. | |

**NOTE** FOC control requires a speed transducer such as an encoder feedback.

## C011 (C054,C097) Type of Reference (Master/Slave)

| | | | |
|---|---|---|---|
| C011 (motor 1)<br>C054 (motor 2)<br>C097 (motor 3) | Range | *0 ÷ 1* | *0: Speed (MASTER mode)*<br>*1: Torque (SLAVE mode)* |
| | Default | 0 | 0: Speed (MASTER mode) |
| | Level | ADVANCED | |
| | Address | 1011<br>1054<br>1097 | |
| | Control | VTC and FOC | |
| | Function | This parameter defines the type of reference to be used. The torque control may be set up (see section 25.1.8). | |

C012 (C055,C098) Speed Feedback from Encoder

| C012 (motor 1)<br>C055 (motor 2)<br>C098 (motor 3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: No<br>1: Yes |
| | Default | 0 | 0 ÷ 1 |
| | Level | BASIC | |
| | Address | 1012<br>1055<br>1098 | |
| | Control | VTC and FOC | |
| | Function | This parameter enables the encoder as a speed feedback.<br>It defines the encoder characteristics and whether Encoder A (MDI6 and MDI7 in the terminal board) or Encoder B (with optional board) is used as a speed feedback (see ENCODER/FREQUENCY INPUTS MENU). | |

C013 (C056, C099) Type of V/f pattern of motor

| C013 (motor 1)<br>C056 (motor 2)<br>C099 (motor 3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 2 | 0: Constant Torque<br>1: Quadratic<br>2: Free Setting |
| | Default | 0 | 0: Constant Torque |
| | Level | BASIC | |
| | Address | 1013, 1056, 1099 | |
| | Control | IFD | |
| | Function | Selects from different types of V/f.<br><br>With **C013 (C056,C099) = Constant torque** it is possible to set only the voltage at zero frequency ( preboost **C034** (**C077,C120**)).<br><br>With **C013 (C056,C099) = Quadratic** it is possible to set the voltage at zero frequency (preboost **C034** (**C077,C120**)), the maximum reduction in voltage with respect to the theoretical V/f pattern **C032** (**C075 C118**) and the frequency to which it has to be realised **C033** (**C076 C119**).<br><br>With **C013 (C056,C099) = Free Setting** it is possible to set the voltage at zero frequency (preboost **C034**(**C077,C120**)), increase voltage to 20% of the rated frequency (Boost0 **C035** (**C078,C121**)) and increase voltage to a programmed frequency (Boost1 **C036** (**C079,C122**), frequency for Boost1 **C037** (**C080,C123**)). | |

C015 (C058, C101) Motor rated frequency

| C015 (motor 1)<br>C058 (motor 2)<br>C101 (motor 3) | | | |
|---|---|---|---|
| | Range | 10 ÷ 10000 | 1.0 Hz ÷ 1000.0 Hz |
| | Default | 500 | 50.0 Hz |
| | Level | BASIC | |
| | Address | 1015, 1058, 1101 | |
| | Control | All | |
| | Function | This parameter defines the motor rated frequency (frequency rating). | |

## C016 (C059,C102) Motor Rated Rpm

| | | | |
|---|---|---|---|
| C016 (motor 1)<br>C059 (motor 2)<br>C102 (motor 3) | Range | 1 ÷ 32000 | 1 ÷ 32000 rpm |
| | Default | 1420 | 1420 rpm |
| | Level | BASIC | |
| | Address | 1016<br>1059<br>1102 | |
| | Function | This parameter defines the motor rated rpm (rpm rating). | |

## C017 (C060,C103) Motor Rated Power

| | | | |
|---|---|---|---|
| C017 (motor 1)<br>C060 (motor 2)<br>C103 (motor 3) | Range | 1 ÷ 19400<br>See Table 53 | 2T: 0.1 ÷ 660.0 kW<br>4T: 0.1 ÷ 1120.0 kW<br>5T: 0.1 ÷ 1620.0 kW<br>6T: 0.1 ÷ 1940.0 kW |
| | Default | See Table 53 | |
| | Level | BASIC | |
| | Address | 1017<br>1060<br>1103 | |
| | Function | This parameter defines the motor rated power (power rating). | |

## C018 (C061,C104) Motor Rated Current

| | | | |
|---|---|---|---|
| C018 (motor 1)<br>C061 (motor 2)<br>C104 (motor 3) | Range | 1 ÷ 12000<br>See Table 52 | 0.1 ÷ 1200.0 A<br>See Table 52 |
| | Default | See Table 52 | |
| | Level | BASIC | |
| | Address | 1018<br>1061<br>1104 | |
| | Function | This parameter defines the motor rated current (current rating). | |

## C019 (C062,C105) Motor Rated Voltage

| | | | |
|---|---|---|---|
| C019 (motor 1)<br>C062 (motor 2)<br>C105 (motor 3) | Range | 50 ÷ 12000 | 5.0 ÷ 1200.0 V |
| | Default | 2300 for inverter class 2T<br>4000 for inverter class 4T<br>5750 for inverter class 5T<br>6900 for inverter class 6T | 230.0V for inverter class 2T<br>400.0V for inverter class 4T<br>575.0V for inverter class 5T<br>690.0V for inverter class 6T |
| | Level | BASIC | |
| | Address | 1019<br>1062<br>1105 | |
| | Function | This parameter defines the motor rated voltage (voltage rating). | |

## C020 (C063,C106) Motor No-Load Power

| | | | |
|---|---|---|---|
| C020 (motor 1)<br>C063 (motor 2)<br>C106 (motor 3) | Range | 0 ÷ 1000 | 0.0 ÷ 100.0% |
| | Default | 0 | 0.0% |
| | Level | ADVANCED | |
| | Address | 1020<br>1063<br>1106 | |
| | Function | This parameter defines the power absorbed by the motor at rated voltage and rated rpm when no load is connected to the motor. | |

## C021 (C064,C107) Motor No-Load Current

| | | | |
|---|---|---|---|
| C021 (motor 1)<br>C064 (motor 2)<br>C107 (motor 3) | Range | 1 ÷ 100 | 1 ÷ 100% |
| | Default | 0 | 0% |
| | Level | BASIC | |
| | Address | 1021<br>1064<br>1107 | |
| | Function | This parameter defines the current absorbed by the motor at rated voltage and rated rpm when no load is connected to the motor. It is expressed as a percentage of the motor rated current **C018** (**C061**, **C104**). For a proper tuning of the current loops required for FOC control, enter a value other than zero.<br>If the stator resistance is tuned (**I073** = [1: Motor Tune]); **1074** = (0: All no rotation)) and the no load current parameter is zero, a value for a first attempt is assigned to this parameter, depending on power and pole torques of the connected motor. | |

## C022 (C065,C108) Motor Stator Resistance

| | | | |
|---|---|---|---|
| C022 (motor 1)<br>C065 (motor 2)<br>C108 (motor 3) | Range | 0 ÷ 32000 | 0.000 ÷ 32.000Ω |
| | Default | See Table 52 | |
| | Level | ADVANCED | |
| | Address | 1022<br>1065<br>1108 | |
| | Function | This parameter defines stator resistance Rs.<br>With a star connection, it matches with the value of the resistance of one phase (half the resistance measured between two terminals); with a delta connection, it matches with 1/3 of the resistance of one phase.<br>Autotune is always recommended. | |

## C023 (C066,C109) Motor Leakage Inductance

| | | | |
|---|---|---|---|
| C023 (motor 1)<br>C066 (motor 2)<br>C109 (motor 3) | Range | 0 ÷ 32000 | 0.00 ÷ 320.00mH |
| | Default | See Table 52 | |
| | Level | ADVANCED | |
| | Address | 1023<br>1066<br>1109 | |
| | Function | This parameter defines the global leakage inductance of the connected motor.<br>With a star connection, it matches with the value of the inductance of one phase; with a delta connection, it matches with 1/3 of the inductance of one phase.<br>Autotune is always recommended. | |

## C024 (C067,C110) Mutual Inductance

| | | | |
|---|---|---|---|
| C024 (motor 1)<br>C067 (motor 2)<br>C110 (motor 3) | Range | 0 ÷ 65000 | 0.00 ÷ 650.00mH |
| | Default | 25000 | 250.00mH |
| | Level | ADVANCED | |
| | Address | 1024<br>1067<br>1110 | |
| | Function | This parameter defines the mutual inductance of the connected motor.<br>The approximate value of the mutual inductance results from no-load current with the formula below:<br>$M \cong (Vnom - Rstat*Io) / (2\pi fnom* Io)$ | |

NOTE

Parameter **C024** (mutual inductance) is **automatically calculated** based on the preset no-load current value (**C021**) whenever parameters **I073** and **I074** are set as follows:
**I073 = [1: Motor Tune]**
**I074 = [0: All no rotation]**
whether current loop tuning is performed or not.

C025 (C068,C111) Rotor Time Constant

| | | | |
|---|---|---|---|
| C025 (motor 1)<br>C068 (motor 2)<br>C111 (motor 3) | Range | 0 ÷ 5000 | 1 ÷ 5000msec |
| | Default | See Table 52 | |
| | Level | ADVANCED | |
| | Address | 1025<br>1068<br>1111 | |
| | Control | FOC | |
| | Function | This parameter defines the rotor time constant of the connected motor.<br>If the rotor time constant is not stated by the motor manufacturer, it can be obtained through the autotune function (see FIRST STARTUP and AUTOTUNE MENU). | |

NOTE

Whenever one of these parameters is written, the drive automatically computes and saves the parameters of flux regulator PI and FOC control: proportional constant for motor 1 **P158** (**P165** for motor 2, **P172** for motor 3) and integral time **P159** (**P166** for motor 2, **P173** for motor 3).

C028 (C071,C114) Motor Min. Speed

| | | | |
|---|---|---|---|
| C028 (motor 1)<br>C071 (motor 2)<br>C114 (motor 3) | Range | 0 ÷ 32000 (*) | 0 ÷ 32000 rpm (*) |
| | Default | 0 | 0 rpm |
| | Level | BASIC | |
| | Address | 1028,1071,1114 | |
| | Function | This parameter defines the minimum speed of the connected motor. When references forming the global reference are at their min. relative value, the global reference equals the min. speed of the connected motor.<br><br>*Example:*<br>**Control Method Menu**<br>**C143** →[1: REF] Selection of reference 1 source<br>**C144** →[2: AIN1] Selection of reference 2 source<br>**C145** →[0: Disable] Selection of reference 3 source<br>**C146** →[0: Disable] Selection of reference 2 source<br><br>**Reference Menu**<br>**P050** →[0: ± 10V] Type of reference for input REF<br>**P051** →[ – 10V] Value of the min. reference for input REF<br>**P052** →[ +10V] Value of the max. reference for input REF<br><br>**P055** →[0: ± 10V] Type of reference for input AIN1<br>**P056** →[ – 5 V] Value of min. reference for input AIN1<br>**P057** →[ +5 V] Value of max. reference for input AIN1<br><br>The speed reference is the min. speed set in **C028** (motor 1) when both input REF and input AIN1 values are lower than or equal to the minimum values set in **P051** and **P056** respectively. | |

(*)NOTE

The maximum allowable value (as an absolute value) for **C028** and **C029** (motor min. and max. speed) depends on the type of control being used, on the rated speed of the connected motor and on the max. carrier frequency (for IFD and FOC only; for VTC control, the max. carrier frequency is always set to 5kHz).

NOTE

The value set as the min. speed is used as the saturation of the global reference; the speed reference will never be lower than the value set as min. speed.

NOTE

The min. speed is not respected only when the REV command or the CW/CCW command are sent after setting a value for max. speed exceeding the min. value (**C029**>**C028** for motor 1) and with the max. reference to the inverter. The motor rpm will be –**C029** <**C028**.

## C029 (C072,C115) Motor Max. Speed

| | | | |
|---|---|---|---|
| **C029 (motor 1)**<br>**C072 (motor 2)**<br>**C115 (motor 3)** | **Range** | 0 ÷ 32000 (*see note in parameter **C028**) | 0 ÷ 32000 rpm (*see note in parameter **C028**) |
| | **Default** | 1500 | 1500 rpm |
| | **Level** | BASIC | |
| | **Address** | 1029<br>1072<br>1115 | |
| | **Function** | This parameter defines the maximum speed of the connected motor. When references forming the global reference are at their max. relative value, the global reference equals the max. speed of the connected motor. | |

## C030 (C073,C116) Flux Weakening Speed

| | | | |
|---|---|---|---|
| **C030 (motor 1)**<br>**C073 (motor 2)**<br>**C116 (motor 3)** | **Range** | 0 ÷ 200 | 0% ÷ 200% |
| | **Default** | 90 | 90% |
| | **Level** | ENGINEERING | |
| | **Address** | 1030<br>1073<br>1116 | |
| | **Control** | FOC | |
| | **Function** | This parameter defines the speed value determining the motor flux weakening.<br>It is expressed as a percentage of the motor rated speed: **C016** (**C059**,**C102**) | |

## C031 (C074,C117) Max. Speed Alarm

| | | | |
|---|---|---|---|
| **C031 (motor 1)**<br>**C074 (motor 2)**<br>**C117 (motor 3)** | **Range** | 0 ÷ 32000 | 0: (Disabled) ÷ 32000 rpm |
| | **Default** | 0 | 0: Disabled |
| | **Level** | ADVANCED | |
| | **Address** | 1031<br>1074<br>1117 | |
| | **Function** | If it is not set to zero, this parameter determines the speed value to be entered for the maximum speed alarm (**A076**). | |

C032 (C075, C118) Reduction in quadratic torque curve

| | | | |
|---|---|---|---|
| C032 (motor 1)<br>C075 (motor 2)<br>C118 (motor 3) | Range | 0-1000 | 0-100.0% |
| | Default | 300 | 30.0% |
| | Level | ADVANCED | |
| | Address | 1032, 1075, 1118 | |
| | Control | IFD | |
| | Function | If the V/f curve pattern **C013 (C056, C099) = Quadratic**, this parameter defines the maximum voltage reduction in terms of the theoretical V/f pattern, actuated to the programmed frequency with **C033 (C076, C119)**. | |

C033 (C076, C119) Rated speed referring to reduction in quadratic torque control

| | | | |
|---|---|---|---|
| C033 (motor 1)<br>C076 (motor 2)<br>C119 (motor 3) | Range | 1-100 | 1-100% |
| | Default | 20 | 20% |
| | Level | ADVANCED | |
| | Address | 1033, 1076, 1119 | |
| | Control | IFD | |
| | Function | If the V/f curve pattern **C013 (C056, C099) = Quadratic**, this parameter defines the frequency on which to actuate maximum reduction in terms of the theoretical V/f pattern programmed with **C032 (C075, C120)**. | |

C034 (C077,C120) Voltage Preboost

| | | | |
|---|---|---|---|
| C034 (motor 1)<br>C077 (motor 2)<br>C120 (motor 3) | Range | 0 ÷ 50 | 0.0 ÷ 5.0 % |
| | Default | See Table 52 | |
| | Level | ADVANCED | |
| | Address | 1034,1077,1120 | |
| | Control | IFD | |
| | Function | Torque compensation at minimum frequency produced by the inverter. Determines the increase of the output voltage at 0Hz. | |

C035 (C078,C121) Voltage Boost at 5% of Rated Frequency

| | | | |
|---|---|---|---|
| C035 (motor 1)<br>C078 (motor 2)<br>C121 (motor 3) | Range | –100 ÷ +100 | –100 ÷ +100 % |
| | Default | 0 | 0 % |
| | Level | ADVANCED | |
| | Address | 1035,1078,1121 | |
| | Control | IFD | |
| | Function | Torque compensation at low rpm. Determines how output voltage varies at 5% of the motor rated frequency with respect to the voltage obtained with a constant V/f pattern (constant voltage frequency). | |

C036 (C079,C122) Voltage Boost at Programmable Frequency

| | | | |
|---|---|---|---|
| C036 (motor 1)<br>C079 (motor 2)<br>C122 (motor 3) | Range | –100 ÷ +400 | –100 ÷ +400 % |
| | Default | 0 | 0 % |
| | Level | ADVANCED | |
| | Address | 1036,1079,1122 | |
| | Control | IFD | |
| | Function | Torque compensation at preset frequency (parameter **C037** for motor 1, **C080** for motor 2 and **C123** for motor 3). Determines how output voltage varies at preset frequency with respect to voltage obtained with a constant V/f pattern (constant voltage frequency). | |

C037 (C080,C123) Frequency for Application of Voltage Boost at Programmable Frequency

| | | | |
|---|---|---|---|
| C037 (motor 1)<br>C080 (motor 2)<br>C123 (motor 3) | Range | 6 ÷ 99 | 6 ÷ 99 % |
| | Default | 50 | 50 % |
| | Level | ADVANCED | |
| | Address | 1037,1080,1123 | |
| | Control | IFD | |
| | Function | Frequency for application of voltage Boost with parameter **C036** for motor 1, parameter **C079** for motor 2 and parameter **C122** for motor 3. This is expressed as a percentage of the motor rated frequency. | |

C038 (C081,C124) Autoboost

| | | | |
|---|---|---|---|
| C038 (motor 1)<br>C081 (motor 2)<br>C124 (motor 3) | Range | 0 ÷ 10 | 0 ÷ 10 % |
| | Default | 1 | 1 % |
| | Level | BASIC | |
| | Address | 1038,1081,1124 | |
| | Control | IFD | |
| | Function | Variable torque compensation expressed as a percentage of the motor rated voltage. The preset value expresses the voltage increase when the motor is running at its rated torque. | |

C039 (C082,C125) Slip Compensation

| | | | |
|---|---|---|---|
| C039 (motor 1)<br>C082 (motor 2)<br>C125 (motor 3) | Range | 0 ÷ 200 | [0: Disabled] ÷ 200 % |
| | Default | 0 | [0: Disabled] |
| | Level | ADVANCED | |
| | Address | 1039,1082,1125 | |
| | Control | IFD | |
| | Function | This parameter represents the motor rated slip expressed as a value percent. If set to 0, this function is disabled. | |

C040 (C083, C126) Decrease in voltage at rated current

| | | | |
|---|---|---|---|
| C040 (motor 1)<br>C083 (motor 2)<br>C126 (motor 3) | Range | 0-500 | 0-50.0% |
| | Default | 0 | 0:Disabled |
| | Level | ADVANCED | |
| | Address | 1040, 1083, 1126 | |
| | Control | IFD | |
| | Function | Defines the increase in voltage (in terms of the corresponding produced frequency) when the current produced by the motor is greater than or equal to the rated current.<br>For example:<br>**C040 = 10%** Decrease in voltage at rated current **C013 = Constant Torque** type of V/f pattern<br>**C015 = 50 Hz** rated frequency<br>**C019= 380 V** rated voltage<br>If the inverter produces an output frequency of 25 Hz it must produce a voltage of 190V. When the output current is equal to the rated current of the motor (**C018**), the voltage actually produced is<br>Vout = 190 * (1+ **C040**/100) = 209V. | |

C041 (C084,C127) Fluxing Ramp Time

| | | | |
|---|---|---|---|
| C041 (motor 1)<br>C084 (motor 2)<br>C127 (motor 3) | Range | 40 ÷ 4000 | 40 ÷ 4000 msec |
| | Default | See Table 52 | |
| | Level | ENGINEERING | |
| | Address | 1041<br>1084<br>1127 | |
| | Control | VTC and FOC | |
| | Function | This parameter indicates the time spent for motor fluxing. | |

## 25.3. TABLE OF THE PARAMETERS DEPENDING ON THE INVERTER SIZE

Table 52: Parameters Depending on the Inverter Size (Class 4T)

| SIZE | MOD. | Inv. Inom [A] | Inv. Imax [A] | Default Carrier [kHz] | Max. Carrier [kHz] | Imot [A] | Def. Rstat. Class 4T [Ω] | Def. Leakage [mH] | Def. M [mH] | Def. τ rot [msec] | Def. Preboost [% Vnom ] | Def. tflux [msec] | Def. tdeflx dcb [msec] | Def. I lim acc/run (%Inom) | Ddef I lim Dec (%Inom ) | Def. Max. Torque (%Cnom) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter ID | M1 | | | C001 C002 | C001 C002 | C018 | C022 | C023 | C024 | C025 | C034 | C041 | C222 | C043, C044 | C045 | C048 |
| | M2 | | | | | C061 | C065 | C066 | C067 | C068 | C077 | C084 | C223 | C086, C087 | C088 | C091 |
| | M3 | | | | | C104 | C108 | C109 | C110 | C111 | C120 | C127 | C224 | C129, C130 | C131 | C134 |
| S05 | 0005 | 10.5 | 11.5 | 5 | 16 | 6.4 | 2.500 | 30.00 | 250.00 | 134 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S05 | 0007 | 12.5 | 13.5 | 5 | 16 | 8.2 | 2.000 | 25.00 | 250.00 | 173 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S05 | 0009 | 16.5 | 17.5 | 5 | 16 | 9 | 1.600 | 16.00 | 250.00 | 192 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S05 | 0011 | 16.5 | 21 | 5 | 16 | 10.9 | 1.300 | 12.00 | 250.00 | 208 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S05 | 0014 | 16.5 | 25 | 5 | 16 | 14.5 | 1.000 | 8.00 | 250.00 | 300 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S10 | 0016 | 26 | 30 | 5 | 16 | 17.6 | 0.800 | 6.00 | 250.00 | 264 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S10 | 0017 | 30 | 32 | 5 | 16 | 17.6 | 0.800 | 6.00 | 250.00 | 264 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S10 | 0020 | 30 | 36 | 5 | 16 | 20.9 | 0.600 | 5.00 | 250.00 | 248 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S10 | 0025 | 41 | 48 | 3 | 16 | 29 | 0.400 | 3.00 | 250.00 | 258 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S10 | 0030 | 41 | 56 | 3 | 16 | 36.1 | 0.300 | 2.50 | 250.00 | 228 | 1.0% | 300 | 50 | 150 | 150 | 120 |
| S10 | 0035 | 41 | 72 | 3 | 16 | 40.1 | 0.250 | 2.00 | 250.00 | 228 | 1.0% | 300 | 70 | 150 | 150 | 120 |
| S15 | 0038 | 65 | 75 | 5 | 16 | 45.6 | 0.200 | 2.00 | 250.00 | 197 | 1.0% | 300 | 70 | 150 | 150 | 120 |
| S15 | 0040 | 72 | 75 | 5 | 16 | 45.6 | 0.200 | 2.00 | 250.00 | 197 | 1.0% | 300 | 70 | 150 | 150 | 120 |
| S20 | 0049 | 80 | 96 | 5 | 12.8 | 56.1 | 0.150 | 2.00 | 250.00 | 208 | 1.0% | 300 | 80 | 150 | 150 | 120 |
| S20 | 0060 | 88 | 112 | 5 | 12.8 | 67.7 | 0.120 | 2.00 | 250.00 | 358 | 1.0% | 300 | 80 | 150 | 150 | 120 |
| S20 | 0067 | 103 | 118 | 5 | 12.8 | 78.7 | 0.100 | 1.20 | 250.00 | 554 | 1.0% | 300 | 100 | 150 | 150 | 114 |
| S20 | 0074 | 120 | 144 | 5 | 12.8 | 83.9 | 0.080 | 1.20 | 250.00 | 628 | 1.0% | 300 | 100 | 150 | 150 | 120 |
| S20 | 0086 | 135 | 155 | 5 | 12.8 | 96.3 | 0.060 | 1.00 | 250.00 | 553 | 1.0% | 300 | 150 | 150 | 150 | 114 |
| S30 | 0113 | 180 | 200 | 3 | 10 | 134.8 | 0.040 | 1.00 | 250.00 | 1310 | 0.5% | 300 | 150 | 150 | 150 | 117 |
| S30 | 0129 | 195 | 215 | 3 | 10 | 143.8 | 0.040 | 1.00 | 250.00 | 1564 | 0.5% | 300 | 150 | 150 | 150 | 119 |
| S30 | 0150 | 215 | 270 | 3 | 5 | 162.8 | 0.030 | 1.00 | 250.00 | 1946 | 0.5% | 300 | 200 | 150 | 150 | 120 |
| S30 | 0162 | 240 | 290 | 3 | 5 | 194.2 | 0.020 | 1.0 | 250.00 | 1764 | 0.5% | 300 | 200 | 150 | 150 | 120 |
| S40 | 0179 | 300 | 340 | 2 | 4 | 211.9 | 0.018 | 1.0 | 250.00 | 1551 | 0.5% | 450 | 200 | 150 | 100 | 120 |
| S40 | 0200 | 345 | 365 | 2 | 4 | 229.9 | 0.018 | 0.90 | 250.00 | 1344 | 0.5% | 450 | 220 | 150 | 100 | 120 |
| S40 | 0216 | 375 | 430 | 2 | 4 | 263.5 | 0.015 | 0.80 | 250.00 | 1169 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S40 | 0250 | 390 | 480 | 2 | 4 | 320.7 | 0.012 | 0.60 | 250.00 | 1075 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S50 | 0312 | 480 | 600 | 2 | 4 | 380.1 | 0.012 | 0.560 | 250.00 | 916 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S50 | 0366 | 550 | 660 | 2 | 4 | 421.3 | 0.010 | 0.40 | 250.00 | 840 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S50 | 0399 | 630 | 720 | 2 | 4 | 482.9 | 0.010 | 0.30 | 250.00 | 733 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S60 | 0457 | 720 | 880 | 2 | 4 | 528 | 0.008 | 0.250 | 250.00 | 733 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S60 | 0524 | 800 | 960 | 2 | 4 | 588.5 | 0.007 | 0.20 | 250.00 | 733 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S60 | 0598 | 900 | 1100 | 2 | 4 | 686.4 | 0.006 | 0.20 | 250.00 | 733 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S70 | 0748 | 1000 | 1300 | 2 | 4 | 848.7 | 0.003 | 0.15 | 250.00 | 733 | 0.5% | 450 | 250 | 150 | 100 | 120 |
| S70 | 0831 | 1200 | 1440 | 2 | 4 | 946.6 | 0.002 | 0.10 | 250.00 | 733 | 0.5% | 450 | 250 | 150 | 100 | 120 |

Table 53: Parameters Depending on the Inverter Size and Voltage Class

| SIZE | MODEL | Pnom default [kW] | | | |
|---|---|---|---|---|---|
| Parameter ID | M1 | C017 | | | |
| | M2 | C060 | | | |
| | M3 | C103 | | | |
| Voltage class | | 2T | 4T | 5T | 6T |
| S05 | 0005 | 1,8 | 3 | --- | --- |
| S05 | 0007 | 2,2 | 4 | --- | --- |
| S05 | 0009 | 3 | 4,5 | --- | --- |
| S05 | 0011 | 3,7 | 5,5 | --- | --- |
| S05 | 0014 | 4,5 | 7,5 | --- | --- |
| S10 | 0016 | 5,5 | 9,6 | --- | --- |
| S10 | 0017 | 5,5 | 9,6 | --- | --- |
| S10 | 0020 | 7,5 | 11 | --- | --- |
| S10 | 0025 | 9,2 | 15 | --- | --- |
| S10 | 0030 | 11 | 18,5 | --- | --- |
| S10 | 0035 | 12,5 | 22 | --- | --- |
| S15 | 0038 | 15 | 26 | --- | --- |
| S15 | 0040 | 15 | 26 | --- | --- |
| S15 | 0049 | 18,5 | 30 | --- | --- |
| S20 | 0060 | 22 | 37 | --- | --- |
| S20 | 0067 | 25 | 45 | --- | --- |
| S20 | 0074 | 30 | 48 | --- | --- |
| S20 | 0086 | 32 | 55 | --- | --- |
| S30 | 0113 | 45 | 75 | --- | --- |
| S30 | 0129 | 50 | 80 | --- | --- |
| S30 | 0150 | 55 | 90 | --- | --- |
| S30 | 0162 | 65 | 110 | --- | --- |
| S40 | 0179 | 75 | 120 | --- | --- |
| S40 | 0200 | 80 | 132 | --- | --- |
| S40 | 0216 | 90 | 150 | --- | --- |
| S40 | 0250 | 100 | 185 | 270 | 330 |
| S50/S65 | 0312 | 132 | 220 | 340 | 410 |
| S50/S65 | 0366 | 150 | 250 | 370 | 450 |
| S50/S65 | 0399 | 160 | 280 | 410 | 490 |
| S60/S65 | 0457 | 200 | 315 | 500 | 590 |
| S60/S65 | 0524 | 220 | 355 | 540 | 650 |
| S60/S65 | 0598 | 250 | 400 | 620 | 740 |
| S65/S70 | 0748 | 280 | 500 | 730 | 870 |
| S65/S70 | 0831 | 330 | 560 | 810 | 970 |

# 26. LIMITS MENU

## 26.1. Overview

The **Limits Menu** defines the current/torque limits applied to the control functions (IFD, VTC or FOC controls) selected for the three connected motors.
For IFD control, current limits are used. Three limit current levels are available, which are expressed as a percentage of the motor rated current:
1) Current limit while accelerating;
2) Current limit at constant rpm;
3) Current limit while decelerating.

Two special parameters are also available; one sets the decrease of the limit current value when the motor runs at constant power (flux weakening), the other disables the frequency decrease in case of acceleration current limit (this is useful for inertial loads).
If a VTC control or a FOC control is used, limits are expressed as a percentage of the motor rated torque.
Values set in the two parameters relating to min. torque and max. torque represent the limits for saturation of the control torque demand. If an external torque limit is set (**C147** in the CONTROL METHOD MENU), the values set in the parameters above represent the range of the source used for limit; the torque ramp times set in the RAMPS MENU will be applied to the preset limit torque reference.
Also, ramp time for torque limit can be selected (**C049** for motor 1, **C092** for motor 2 and **C135** for motor 3) for VTC and FOC controls only.

## 26.2. List of Parameters from C043 to C135

Table 54: List of Parameters C043 ÷ C135

| Parameter | | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|---|
| C043 | M1 | Current limit while accelerating | BASIC | 1043 | See Table 52 |
| C086 | M2 | | ADVANCED | 1086 | See Table 52 |
| C129 | M3 | | ADVANCED | 1129 | See Table 52 |
| C044 | M1 | Current limit at constant rpm | BASIC | 1044 | See Table 52 |
| C087 | M2 | | ADVANCED | 1087 | See Table 52 |
| C130 | M3 | | ADVANCED | 1130 | See Table 52 |
| C045 | M1 | Current limit while decelerating | BASIC | 1045 | See Table 52 |
| C088 | M2 | | ADVANCED | 1088 | See Table 52 |
| C131 | M3 | | ADVANCED | 1131 | See Table 52 |
| C046 | M1 | Current limit decrease in flux weakening | ADVANCED | 1046 | 0: Disabled |
| C089 | M2 | | ADVANCED | 1089 | 0: Disabled |
| C132 | M3 | | ADVANCED | 1132 | 0: Disabled |
| C047 | M1 | Minimum torque | ADVANCED | 1047 | 0.0% |
| C090 | M2 | | ADVANCED | 1090 | 0.0% |
| C133 | M3 | | ADVANCED | 1133 | 0.0% |
| C048 | M1 | Maximum torque | ADVANCED | 1048 | 120.0% |
| C091 | M2 | | ADVANCED | 1091 | 120.0% |
| C134 | M3 | | ADVANCED | 1134 | 120.0% |
| C049 | M1 | Ramp time for torque limit | ADVANCED | 1049 | 50ms |
| C092 | M2 | | ADVANCED | 1092 | 50ms |
| C135 | M3 | | ADVANCED | 1135 | 50ms |
| C050 | M1 | Reduced motor revs in acceleration limit | ADVANCED | 1050 | 0: Disabled |
| C093 | M2 | | ADVANCED | 1093 | 0: Disabled |
| C136 | M3 | | ADVANCED | 1136 | 0: Disabled |

## C043 (C086, C129) Current Limit While accelerating

| C043 (motor 1)<br>C086 (motor 2)<br>C129 (motor 3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 400 (*) | 0: Disabled<br>1.0% ÷ Min[*Imax inverter/Inom mot, 400.0%*] |
| | Default | See Table 52 | |
| | Level | BASIC (C043); ADVANCED (C086, C129) | |
| | Address | 1043,1086,1129 | |
| | Control | IFD | |
| | Function | This parameter defines the current limit while accelerating; it is expressed as a percentage of the rated current of the selected motor. | |

(*) *The maximum allowable value depends on the inverter size.*

## C044 (C087, C130) Current Limit at Constant Rpm

| C044 (motor 1)<br>C087 (motor 2)<br>C130 (motor 3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 400 (*) | 0: Disabled<br>1.0% ÷ Min[*Imax inverter/Inom mot, 400.0%*] |
| | Default | See Table 52 | |
| | Level | BASIC (C044); ADVANCED (C087, C130) | |
| | Address | 1044,1087,1130 | |
| | Control | IFD | |
| | Function | This parameter defines the current limit at constant rpm; it is expressed as a percentage of the rated current of the selected motor. | |

(*) *The maximum allowable value depends on the inverter size.*

## C045 (C088, C131) Current Limit while Decelerating

| C045 (motor 1)<br>C088 (motor 2)<br>C131 (motor 3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 400 (*) | 0: Disabled<br>1.0% ÷ Min[*Imax inverter/Inom mot, 400.0%*] |
| | Default | See Table 52 | |
| | Level | BASIC (C045); ADVANCED (C088, C131) | |
| | Address | 1045,1088,1131 | |
| | Control | IFD | |
| | Function | This parameter defines the current limit while decelerating; it is expressed as a percentage of the rated current of the selected motor. | |

(*) *The maximum allowable value depends on the inverter size.*

## C046 (C089, C132) Current Limit Decrease in Flux Weakening

| C046 (motor 1)<br>C089 (motor 2)<br>C132 (motor 3) | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: Disabled<br>1: Enabled |
| | Default | *0* | 0: Disabled |
| | Level | ADVANCED | |
| | Address | 1046,1089,1132 | |
| | Control | IFD | |
| | Function | This parameter enables the current limit decrease function in flux weakening. The current limit is multiplied by the ratio between the motor rated torque and the frequency forced to the inverter:<br>limit = current limit being used * (Fnom/ Fout). | |

C047 (C090, C133) Minimum Torque

| | | | |
|---|---|---|---|
| C047 (motor 1)<br>C090 (motor 2)<br>C133 (motor 3) | Range | –5000 ÷ 5000 (*) | –500.0% ÷ +500.0% |
| | Default | 0 | 0.0% |
| | Level | ADVANCED | |
| | Address | 1047, 1090, 1133 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the min. limit of the torque demanded by the control being used.<br>Torque is expressed as a percentage of the rated torque of the selected motor. | |

NOTE

If an external torque limit is set (**C147** in the **Control Method Menu**), the values set in the parameters above represent the range of the source used for limitation; the torque ramp times set in the Ramps Menu will be applied to the preset limit torque reference (**P026–P027**).

C048 (C091, C134) Maximum Torque

| | | | |
|---|---|---|---|
| C048 (motor 1)<br>C091 (motor 2)<br>C134 (motor 3) | Range | –5000(*) ÷ 5000 (*) | –500.0% ÷ +500.0% |
| | Default | 1200 (**) | 120.0% |
| | Level | ADVANCED | |
| | Address | 1048, 1091, 1134 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the max. limit of the torque demanded by the control being used.<br>Torque is expressed as a percentage of the rated torque of the selected motor. | |

NOTE

If an external torque limit is set (**C147** in the **Control Method Menu**), the values set in the parameters above represent the range of the source used for limitation; the torque ramp times set in the Ramps Menu will be applied to the preset limit torque reference (**P026–P027**).

C049 (C092, C135) Ramp time for torque limit

| | | | |
|---|---|---|---|
| C049 (motor 1)<br>C092 (motor 2)<br>C135 (motor 3) | Range | 10 ÷ 30000 | 10 ÷ 30000ms |
| | Default | 50 | 50ms |
| | Level | ADVANCED | |
| | Address | 1049, 1092, 1135 | |
| | Control | VTC and FOC | |
| | Function | This parameter determines the time taken by the torque limit of the selected motor to go to zero from max. value. | |

C050 (C093, C136) Reduced motor revs in acceleration limit

| | | | |
|---|---|---|---|
| C050 (motor 1)<br>C093 (motor 2)<br>C136 (motor 3) | Range | 0 ÷ 1 | 0: No<br>1: Yes |
| | Default | 0 | 0: Disabled |
| | Level | ADVANCED | |
| | Address | 1050, 1093 1136 | |
| | Control | IFD | |
| | Function | This parameter disables frequency decrease in acceleration limit. | |

# 27. CONTROL METHOD MENU

## 27.1. Overview

NOTE

Please refer to Sinus Penta **Installation Instructions** manual for the hardware description of digital inputs (COMMANDS) and analog inputs (REFERENCES).
See also the INPUT REFERENCES MENU and the DIGITAL INPUTS MENU.

With the factory-setting the inverter receives the digital commands via the terminal board, the main speed reference is sent from the REF analog input, and no external limit for torque limitation is enabled.

The parameters in this menu allow for the selection of the following:

- the source of the **inverter commands** (digital inputs) from **three signal sources** (through the parameters **C140, C141, C142**) which are combined so as to obtain an active **M031** command set. For each of these 3 **parameters** it is possible to select the source of the command signals from **4 different sources**;
- the source of the **speed reference** (or torque reference) from **4 different sources** (that can be selected with parameters **C143, C144, C145, C146)** and **add up the 4 different sources.**

For each of these **4 parameters**, it is possible to select the source of the reference signals from **9 different sources**;

- the source of the **torque limit** reference (through parameter **C147**). With this **parameter** it is possible to select the reference source from **9 different sources.**

Therefore it is possible to select and enable different **command sources** (hardware or virtual sources), different speed (or torque) **references** (hardware or virtual sources) and enable an external torque **limit**.
The inverter **commands** may be sent from:

- the hardware terminal board (terminal board on board ES821), logically separated between terminal A and terminal B;
- keypad;
- remote virtual terminal board: through serial link with MODBUS communication protocol;
- remote virtual terminal board: through Field bus (optional board).

Multiple terminal boards may also be enabled (up to 3 terminal boards with parameters **C140, C141, C142**); in this case, the inverter will apply logic functions **OR** or **AND** to the different terminals to obtain the activated terminal board (see section 27.1.1).

The following **references** and torque limit signals may be sent:

- three analog inputs acquired on the hardware terminal board (REF, AIN1, AIN2);
- frequency input FIN;
- encoder input;
- keypad;
- serial link with MODBUS communication protocol;
- Field bus (optional board);
- Up Down from MDI (Up and Down digital inputs)

Multiple reference sources may be enabled at the same time (up to 4 reference sources with parameters **C143, C144, C145, C146**); in this case, the inverter will consider the sum of all active reference as the main reference.

Finally, it's also possible to select dynamically between two command sources and two reference sources using the digital input configured as Source Selection (see **C179**).

### 27.1.1. COMMAND SOURCES

The inverter commands may be sent from the following sources:

0: Disabled
1: Terminal board A
2: Serial link (with MODBUS protocol)
3: Field bus (field bus on optional board)
4: Terminal board B
5: Keypad (remotable display/keypad)

The factory-setting enables the same command source Terminal A (**C140**=1 and **C141**=1) (see also DIGITAL INPUTS MENU). Both Terminal board A and B refer to the same terminal board on ES821, but allow to switch between one set of START, STOP, REVERSE commands on three terminals to another set on other three different terminals.

Most commands may be delayed (when enabled or disabled): refer to the TIMERS MENU.

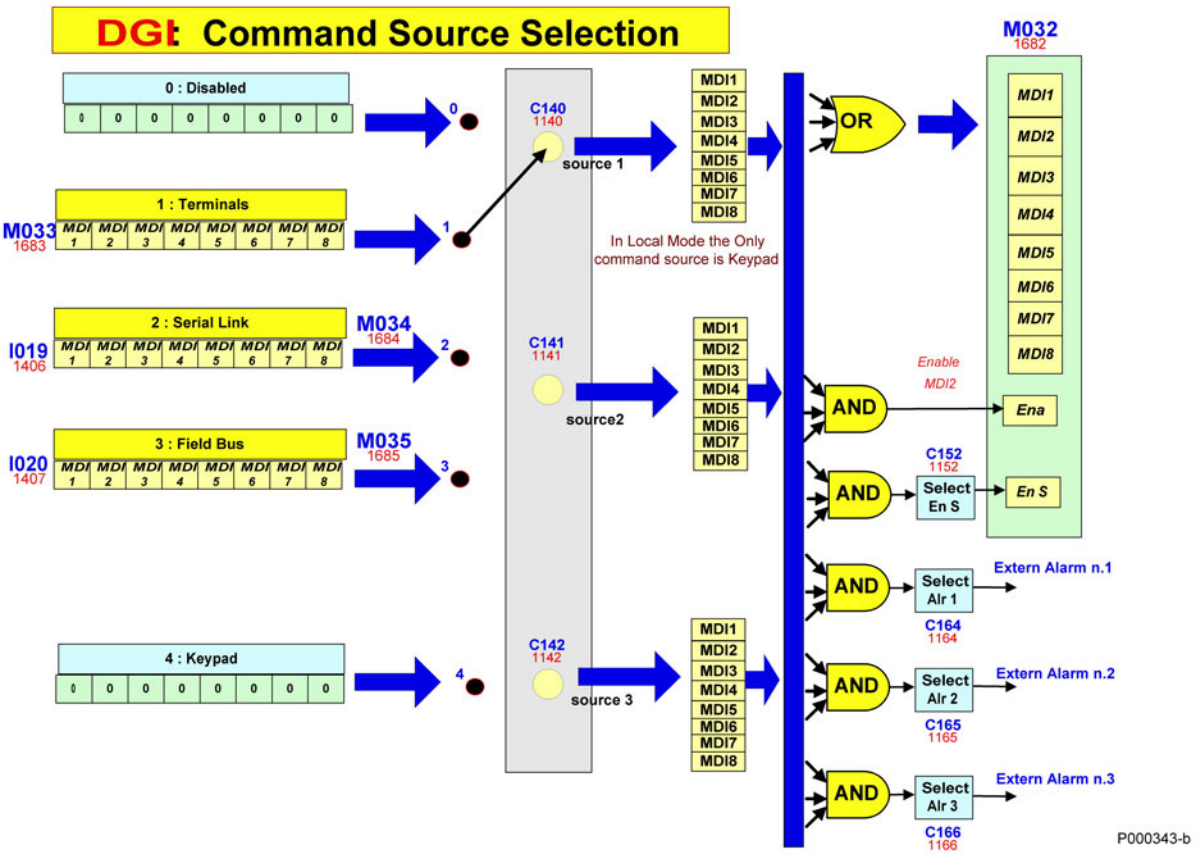



Figure 34: Selecting the Command Sources

If the keypad is not selected as a command source or if the **STOP** input function is enabled (**C150**≠0), more than one command source may be enabled at a time. In this case, the logic function accomplished by the inverter for the terminals of all active command sources is the following:

- **AND** for terminals where the functions **ENABLE, ENABLE–S, External Alarms no.1, no.2, no.3** are programmed;
- **OR** for all other terminals.

NOTE

If the keypad is enabled as a command source, the **START**, **STOP**, **RESET**, **FWD/REV**, **LOC/REM** functions are enabled (to disable **FWD/REV LOC/REM** see parameter **P269**). The keypad is ignored for the processing of logic functions (AND/OR) of the other command sources that are enabled at that moment.

NOTE

As the **ENABLE** command of the **hardware terminal board** is a hardware safety device (it enables the inverter) it is always active: even when none of the parameters **C140, C141** or **C142** selects the terminal board (=1).

NOTE

The commands for the **External Alarm no.1, no.2, no.3** functions are always and only considered on the inverter terminal board.

NOTE

The ***LOCAL mode,*** that can be enabled with the **LOC/REM** key on the keypad or with the **LOCAL** command function from the terminal board (see **C180**), forces the keypad as the only command source, thus ignoring the values set in parameters **C140**, **C141**, **C142**.
In this case the following functions are in any case enabled on the hardware terminal board: **External Alarm no.,1 no.2, no.3**, **Motor Sel. no.2**, **Motor Sel. no.3**, **SLAVE**, **PID Disable**, **LOCAL** and the **ENABLE** and **RESET** functions are always enabled on terminals **MDI2** and **MDI3**.

**Table 55: Remote command inputs (Serial)**

| MODBUS Address | Input Code | Access Level | Description | Range |
|---|---|---|---|---|
| 1406 | **I019** | ADVANCED | Remote, virtual terminal board from serial link | Bit input: 0÷1 for 8 bits corresponding to MDI1÷ MDI8 |

**Example:**

By setting **C140** = 3 (Field bus) and **C141** = 2 (Serial link), the **ENABLE** command is sent by closing terminal **MDI2** on the terminal board and (AND) by forcing bit **MDI2** from the serial link on input **I019** (address MODBUS 1406) **and** bit **MDI2** from Field Bus (see FIELD BUS CONFIGURATION MENU).
The **START** command may also be sent (OR) by forcing bit **MDI1** from serial link on input **I019 or** by forcing bit **MDI1** from Field Bus on the relative variable.

## 27.1.2. SPEED/TORQUE REFERENCE SOURCES

The "**main reference**" is the value at constant speed to be attained by the controlled variable (speed or torque) (**M000**, **M007**) "required" from the inverter.
This reference is acquired by the inverter only if the **START** command and the **ENABLE** commands are active; otherwise, it is ignored.
When the main reference is acquired by the inverter (**START** and **ENABLE** are active), it becomes the input signal managed by the "time ramp" functions that generate the speed/torque reference setpoint for the connected motor.

**The speed or torque references** may come from these command sources:
0. **Source disabled;**
1. **REF** (*single–ended analog input from terminal board*);
2. **AIN1** (*differential analog input from terminal board*);
3. **AIN2** (*differential analog input from terminal board*);
4. **FIN** (*frequency input from terminal board see also ENCODER/FREQUENCY INPUTS MENU);*
5. **Serial link** (*with MODBUS protocol*);
6. **Field Bus** (*field bus on optional board*);
7. **Keypad** (*remotable display/keypad*);
8. **Encoder** (*on terminal board MDI6–ECHA, MDI7–ECHB or optional board*);
9. **Up Down from MDI** *(Up down from digital inputs see* **C161** and **C162**).

NOTE If multiple reference sources are selected the processed reference is the **algebraic sum of all enabled references**.

**REF, AIN1 and AIN2**

The sources REF, AIN1 and AIN2 come from the analog inputs on the terminal board and they generate a reference resulting from the setting of the relevant parameters (from **P050** to **P064**). See INPUT REFERENCES MENU for the scaling, offset compensation and filtering of the reference obtained. The inputs may be used in voltage or current depending on the setting and the position of the dip-switch (see the Installation manual).

**FIN**

The ***FIN*** source is a frequency input on terminal **MDI6 (FINA)** or **MD18 (FINB)** and it generates a reference determined by the setting of the relevant parameters (from **P071** to **P072**), allowing scaling (see INPUT REFERENCES MENU and ENCODER/FREQUENCY INPUTS MENU).

SERIAL LINK

The ***Serial Link*** source is an input on the MODBUS link: the reference value must be written by the user at the addresses below:

Table 56: Serial Reference Inputs

| MODBUS Address | Input Code | Access Level | Reference | Description | Range | Unit of measure |
|---|---|---|---|---|---|---|
| 1412 | **I025** | ADVANCED | Speed | Speed reference (integral) | Min. speed ÷ Max. speed | RPM |
| 1413 | **I026** | ENGINEERING | Speed | Speed reference (decimal portion) | –99 ÷ 99 | RPM/100 |
| 1416 | **I029** | ADVANCED | Torque | Torque reference or torque limit (integral) | Min. torque ÷ Max. torque | Tenths % |

NOTE

**I025** is the speed reference in RPM; its range depends on the active Minimum Speed value and Maximum Speed value as indicated by the **C028** and **C029** parameters (for motor 1, and relevant parameters for motor 2 and motor 3).
If **C029** ≤ **C028**, then **Min. speed** = **C029**, **Max. speed** = **C028**.
If **C029** ≥ **C028**, then **Min. speed** = **C028**, **Max. speed** = **C029**.
**I029** is the signal is used as a torque reference or as a Torque Limit. It is expressed as a percentage of the max. absolute torque set with the parameters **C047** and **C048** (motor 1, and relevant parameters for motor 2 and motor 3). The max. absolute torque is the max. value between absolute values of parameters **C047** and **C048**.

NOTE

**Max. absolute torque** = Max( | **C047** | , | **C048** |)
The unit of measure is tenths of %:
**Torque reference** % = (**I029***0.1) %
Reference range:
If **C047** ≤ **C028**, then **Min. speed** = **C029**, **Max. speed** = **C028**.
If **C029** ≥ **C028**, then **Min. speed** = **C028**, **Max. speed** = **C029**.
Example: 1200 = 120.0%

FIELD BUS

For a description of the **Field Bus** source, see FIELD BUS CONFIGURATION MENU.

KEYPAD

NOTE

The keypad is a particular reference source. The keypad reference may be modified with the keys ▲ and ▼ only if this reference is on a Keypad page where there is a reference on the fourth line.
If the keypad is enabled it is possible to add a **variation** to the active reference by way of an algebraic sum (calculated by processing the other reference sources that are activated at that moment).
The reference variation method can be selected with parameters **P067**, **P068**, **P069**, and **C163**.
This function is the same as the **UP** and **DOWN** functions from the terminal board (see DIGITAL INPUTS MENU**: C161** and **C162 and P068÷P069** in the INPUT REFERENCES MENU).

NOTE

The ***LOCAL mode,*** that can be enabled with the ***LOC/REM key*** on the keypad or with the **LOCAL** command function from terminal board (see **C180**), forces the keypad to become the only command and reference source, thus ignoring the values set in parameters **C143**, **C144**, **C145, C146**.

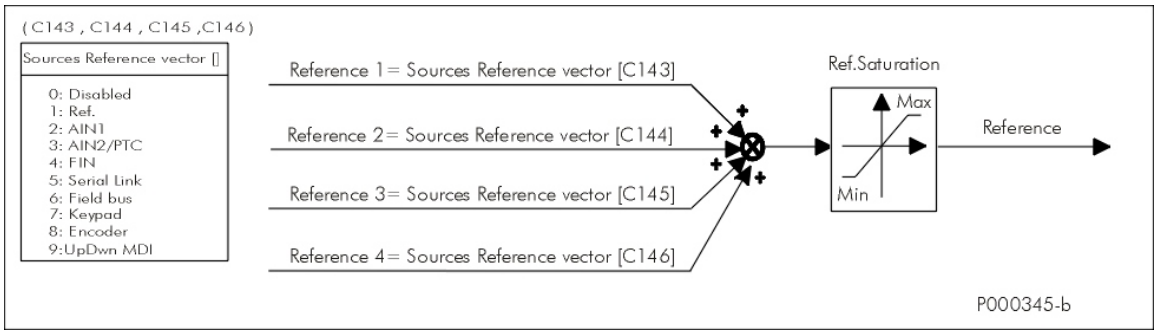
ENCODER

The ***Encoder*** source is an encoder input: it can come from the terminal board (terminals **MDI6**, **MDI7**) Encoder A, or from the optional encoder board Encoder B (see ENCODER/FREQUENCY INPUTS MENU). It generates a reference resulting from the correct setting of the relevant parameters (**P073**, **P074**), allowing the relevant scaling (see INPUT REFERENCES MENU).

UP/DOWN from digital inputs

To enable the **UP/DOWN from digital inputs** also set the respective Up and Down inputs (see DIGITAL INPUTS MENU).

**Figure 35: Selecting the Reference Sources**




## 27.1.3. ALTERNATIVE COMMAND AND REFERENCE SOURCES

It is possible to set a digital input as a selector between 2 alternative command and reference sources.

For example:

**C179** MDI to select sources = **MDI6**
**C140** To select command source number 1 = **Keypad**
**C141** To select command source number 2 = **Field Bus**
**C143** To select reference source number 1 = **AIN1**
**C144** To select reference source number 2 = **Field Bus**

If MD16 (on the inverter's terminal board) set as the selector between the sources is open, the inverter will consider number 1 as reference and command sources (that is **C140 = Keypad** and **C143 = AIN1**), whilst if it is closed number 2 will be considered (**C141 = Field Bus** and **C144 = Field Bus**).
If the references sources 3 and 4 (**C145 and C146**) are not set as disable the reference given for these latter two sources shall be a sum of the source selected by the vector MD16.

See **C179** in DIGITAL INPUTS MENU.

### 27.1.4. TORQUE LIMIT SOURCE

The source of the Torque Limit can be selected with parameter **C147**.
The Torque limit function is a limit of the absolute value of the torque required from the inverter.
(– Torque limit) <= torque <= (+ Torque limit)

The torque limit references may be selected from the following:

0. **Source disabled**
1. **REF** (*single–ended analog input from terminal board*);
2. **AIN1** (*differential analog input from terminal board*);
3. **AIN2** (*differential analog input from terminal board see also ENCODER/FREQUENCY INPUTS MENU);*
4. **FIN** (*frequency input from terminal board*);
5. **Serial link** (*with MODBUS protocol*);
6. **Field Bus** (*field bus on optional board*);
7. **Keypad** (*remotable display/keypad*);
8. **Encoder** (*in terminal board MDI6–ECHA , MDI7–ECHB or optional board*);
9. **Up Down from MDI** *(Up down from digital inputs see **C161 and C162**)*

NOTE

If the reference source is disabled, the torque limit results from the max. absolute torque determined by the inverter size and the motor size.
The max. absolute torque is the max. value ranging between the absolute values of **C047** and **C048** (motor 1, and relevant parameters for motor 2 and motor 3).
**Max. absolute torque** = Max( | **C047** | , | **C048** |)

With the factory-setting (**C147**=0) the reference source is disabled and the torque limit is given by the max. absolute torque.

### 27.1.5. REMOTE/LOCAL

With the factory-setting the changeover from the **Remote** mode to the **Local** mode can only be made when the inverter is disabled, for which the former reference and command sources depend upon the setting of the parameters **C140**÷**C147**, and for the latter the command and reference functions are activated only from the keypad.
With the parameter **C148** it is possible to customise the Loc/Rem function if the function is to be set also when the inverter is enabled or if during the changeover from remote to local the same condition is desired and if the same reference is to be maintained.

NOTE

For further details regarding the Loc/Rem function see also section 1.10 and DIGITAL INPUTS MENU.

## 27.2. List of Parameters from C140 to C148

Table 57: List of Parameters C140 ÷ C148

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| C140 | Command digital input 1 | ADVANCED | 1140 | 1:Terminal Board |
| C141 | Command digital input 2 | ADVANCED | 1141 | 1:Terminal Board |
| C142 | Command digital input 3 | ENGINEERING | 1142 | 0 |
| C143 | Input reference 1 | ADVANCED | 1143 | 1: REF |
| C144 | Input reference 2 | ADVANCED | 1144 | 2: AIN1 |
| C145 | Input reference 3 | ENGINEERING | 1145 | 0 |
| C146 | Input reference 4 | ENGINEERING | 1146 | 0 |
| C147 | Torque Limit input | ENGINEERING | 1147 | 0 |
| C148 | Changeover from remote to local command | ENGINEERING | 1148 | 0: StandBy + Fluxing |

NOTE

The range of the parameters **C140**, **C141**, **C142** depends on the setting of parameter **C150** and vice versa (see the detailed description of these parameters).

C140 (C141, C142) Command source selection 1 (2, 3)

| | | | |
|---|---|---|---|
| C140 (C141, C142) | Range | 0 ÷ 5 | 0: Disabled,<br>1: Terminal Board,<br>2: Serial Link,<br>3: Field Bus,<br>4: Terminal Board B,<br>5: Keypad |
| | Default | **C140** ÷ **C141** = 1<br>**C142** = 0 | **C140** ÷ **C141** = 1: Terminal Board<br>**C142** = 0: Disabled |
| | Level | **C140** ÷ **C141** ADVANCED; **C142** ENGINEERING | |
| | Address | 1140 (1141,1142) | |
| | Function | Selection of the inverter command source. | |

NOTE

If the command source is set as Keypad it is possible to set other command sources only if the STOP or STOP B digital inputs are set (see **C150** and **C150a**) to enable pushbutton operation or ensure the Source Selection function is activated (see **C179**).

NOTE

If the first command source is already set and is not a Keypad source, it is possible to set the Keypad as a second or third source, only if STOP or STOP B inputs are set (**C150** ≠ 0 or **C150a** ≠ 0) to enable pushbutton operation or ensure the Source Selection function is activated (see **C179**).

## C143 (C144, C145, C146) Selection Reference 1 (2, 3, 4)

| | | | |
|---|---|---|---|
| **C143 (C144, C145, C146)** | **Range** | 0 ÷ 9 | 0: Disabled,<br>1: REF,<br>2: AIN1,<br>3: AIN2,<br>4: Frequency input,<br>5: Serial Link,<br>6: Field Bus,<br>7: Keypad,<br>8: Encoder,<br>9: UpDown from MDI |
| | **Default** | **C143** = 1, **C144** = 2<br>**C145** ÷ **C146** = 0 | **C143** = 1: REF, **C144** = 2: AIN1<br>**C145** ÷ **C146** = 0 : Disabled |
| | **Level** | **C143** ÷ **C144** ADVANCED; **C145** ÷ **C146** ENGINEERING | |
| | **Address** | 1143 (1144, 1145, 1146) | |
| | **Function** | This parameter selects sources for the speed (or torque) reference.<br>The reference resulting from the sum of the selected sources represents the inverter speed or torque reference. If the PID action has been set as reference **C294 = Reference**, the inverter speed or torque references shall only be given by the PID output and not by the sources set in **C143 ÷ C146**. | |

## C147 Torque Limit Input

| | | | |
|---|---|---|---|
| **C147** | **Range** | 0 ÷ 9 | 0: Disabled,<br>1: REF,<br>2: AIN1,<br>3: AIN2,<br>4: Frequency input,<br>5: Serial Link,<br>6: Field Bus,<br>7: Keypad,<br>8: Encoder,<br>9: UpDown from MDI |
| | **Default** | 0 | 0: Disabled |
| | **Level** | ENGINEERING | |
| | **Address** | 1147 | |
| | **Control** | VTC and FOC | |
| | **Function** | If a speed control with FOC or VTC control algorithms is used it is possible to use an external torque limit. Parameter **C147** selects the Torque Limit source. At the selected torque limit source reference the torque ramp times set in **P026–P027** shall be applied. The external torque limit may be disabled by closing the digital input set with **C187.** | |

**NOTE**

If the reference source is disabled, the torque limit results from the max. absolute torque determined by the inverter size and the motor size.
The max. absolute torque is the max. value ranging between the absolute values of **C047** and **C048** (motor 1, and relevant parameters for motor 2 and motor 3).
**Max. absolute torque** = Max( | **C047** | , | **C048** |)

With the factory-setting (**C147**=0) the reference source is disabled, so the torque limit depends on the max. absolute torque (see also INPUT REFERENCES MENU).

C148 Changeover from Remote to Local command

| | | | |
|---|---|---|---|
| C148 | Range | 0 ÷ 3 | 0: StandBy + Fluxing<br>1: Drive Running / No Bumpless<br>2: Drive Running / Commands Bumpless<br>3: Drive Running / All Bumpless |
| | Default | 0 | 0: StandBy + Fluxing |
| | Level | ENGINEERING | |
| | Address | 1148 | |
| | Function | With the factory-setting the changeover from Remote to Local mode functioning (and vice versa) may be carried out only when not running.<br>To follow are the descriptions of the other settings possible with **C148:** the changeover from local to remote mode functioning and vice versa can also be carried out when running.<br><br>• **No Bumpless** → During the changeover from Remote to Local mode functioning the inverter will be sent to a speed or torque reference at zero and it will be always be necessary to push **START** to run.<br>• **Commands Bumpless** → During the changeover from Remote to Local mode functioning the inverter will find a reference of speed/torque to zero but the running will remain the same as in the remote mode; for example if in the Remote mode the motor is running, in the Local mode the inverter remains running with a modifiable reference with **INC/DEC** starting at zero.<br>• **All Bumpless** → During the changeover from Remote to Local mode functioning the inverter will maintain the same speed/torque reference and the same running condition that was in the remote mode; for example if in the Remote mode the motor is running at 1000 rpm, in the local mode the inverter remains running with a reference of 1000 rpm that can be modified with **INC/DEC** starting at zero. | |

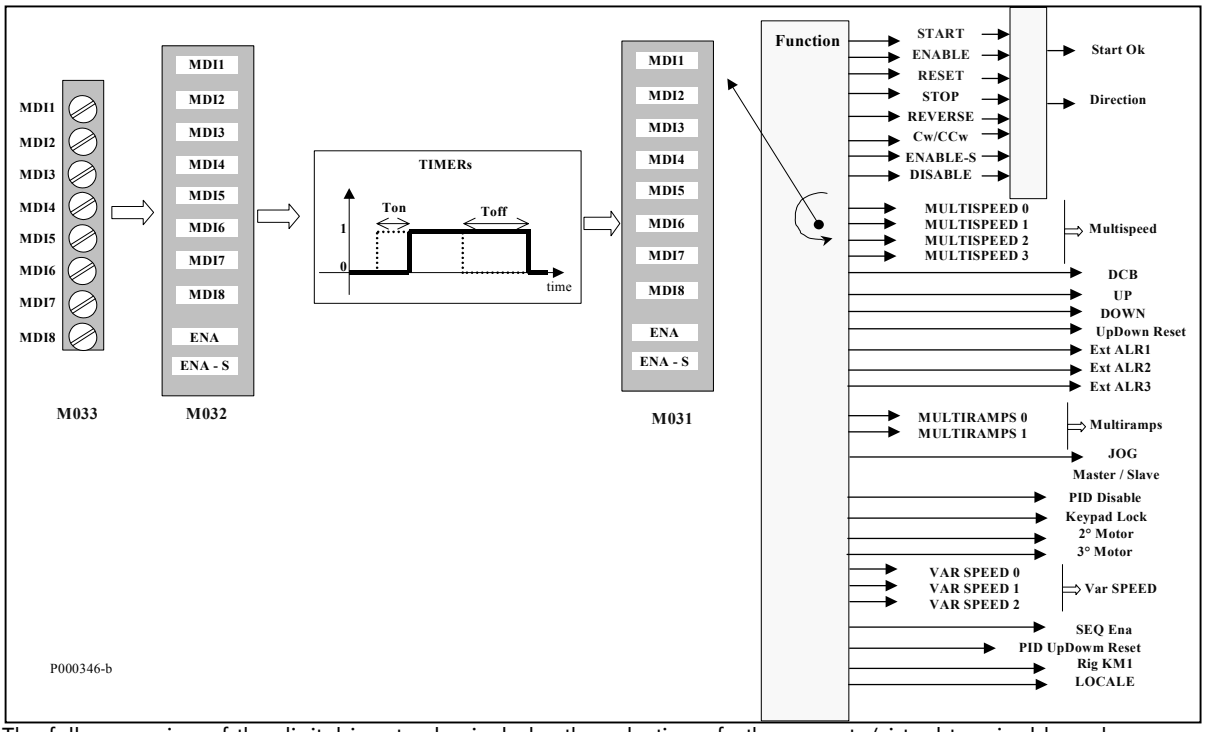
# 28. DIGITAL INPUTS MENU

## 28.1. Overview

NOTE

Please refer to the Sinus Penta Installation Instructions manual for a description of the digital inputs.

The parameters in this menu assign particular digital control functions to each digital input on the terminal board. Each parameter has a particular function, which is assigned to a given terminal on the terminal board.




The full processing of the digital inputs also includes the selection of other remote/virtual terminal boards (see CONTROL METHOD MENU) and the possibility of delaying input digital signal enabling/disabling by means of software timers (see TIMERS MENU).

According to the above figure the digital input status is displayed in the measures **M031**, **M032**, **M033**.

measure **M033** shows the **current** status of the 8 inputs on the local terminals hardware on the inverter board.

On the display/keypad the symbol À displays the logic levels for terminals **M033** for inactive inputs, and

active inputs are displayed with symbol Ú.

measure **M032** shows the **current** status of the virtual terminal board obtained by processing all active terminal boards. It includes 10 signals, with two additional signals with respect to the local hardware terminal board:

- Inputs **MDI1 ~ MDI8** are obtained with the **logic OR** of the input signals for all active terminals;
- The **ENABLE** input is obtained with the logic **AND** of the input signals for terminal **MDI2** in all active terminal boards;

The **ENABLE–S** input is obtained with the logic **AND** of the terminals selected for this function in all active terminal boards.

- measure M031 is similar to M032, but it displays the status of the terminal board obtained after any eventual delay on the part of the timers of the M032digital inputs.

The inverter uses this terminal board to acquire digital commands.
Some functions cannot be programmed, but they are assigned to special terminals:

**Table 58: Functions that cannot be programmed**

| *Function* | *Terminal* |
|---|---|
| START | MDI1 |
| ENABLE | MDI2 |
| RESET | MDI3 (can be disabled with C154=Yes) |

Some terminals in the local hardware terminal board can also be used for other functions:

**Table 59: Terminals used for other inputs.**

| *Terminal* | *Description* |
|---|---|
| MDI6 | ECHA: channel A of **encoder A** on the terminal board |
| MDI7 | ECHB: channel B of **encoder A** on the terminal board |
| MDI8 | FIN: frequency input |

### 28.1.1. START (TERMINAL 14:MDI1)

To activate this input function set the control mode from the terminal control (factory-setting). The START command can also be sent from the keypad/display.
The enabling/disabling of the MDI1 input can be delayed by means of timers.
The START input function is assigned to terminal MDI1 and cannot be set on other terminals, the same terminal may be assigned to other functions in addition to START.
It is possible to set the stalling mode (C185), which at the START up command may be:
with the deceleration ramp or idling, and also if there is the need to flux the engine (VTC, FOC) only when the START command is shut down and not with ENABLE inactive (C184).
When START is **active** (also when ENABLE is active), RUN is enabled: the speed (or torque) *setpoint* increases proportionally to the preset ramp until it reaches the active *reference*. (IFD control: in order to enable the RUN command, the main speed reference must not be zero).
When START is **inactive** (even when ENABLE is active) RUN is disabled: the reference is set to zero and the speed (or torque) setpoint decreases down to zero depending on the preset deceleration ramp.

NOTE

The way the START enables or disables the RUN command also depends on the setup of other functions, in particular the STOP, REVERSE and JOG functions (see parameters C150, C151, C169).
If the REVERSE (C151≠0) function is enabled, it can enable/disable the RUN command. If however, the START and REVERSE commands are both active, the RUN command is disabled.
*In this case, START is interpreted as FORWARD and REVERSE as REVERSE. When both Start and Reverse are active, the system cannot interpret the query to be FORWARD or REVERSE.*
If the JOG function is enabled (C169≠0), it can enable/disable the RUN command, but only if the RUN command has not been previously enabled by other functions.
If the STOP function is enabled (C150≠0), the RUN command may be enabled/disabled only by pressing the relative "key": see descriptions of the STOP function (C150).

NOTE

If only the keypad is enabled as the command source, press the START key on the keypad to enable the inverter RUN and press the STOP key to disable the inverter RUN.

NOTE

By setting C185 = Free Wheel when activating the start command, the inverter will not carry out the deceleration ramp and goes into stand-by.

## 28.1.2. ENABLE (TERMINAL 15:MDI2)

The **ENABLE** input function is assigned to terminal **MDI2**. It **enables the functioning of the inverter**. It cannot be programmed on other terminals, although additional functions may be assigned to the **ENABLE** terminal.
The **ENABLE** input must always be active on all activated terminals to enable the inverter to function, irrespective of the control mode.
If the **ENABLE** input is disabled, the inverter output voltage is always cut off, so the connected motor starts **idling** (the motor idles and stops due to either friction or to the mechanical load).
In the case of towed loads, (like lifting), when the motor is idle a mechanical load could bring about uncontrolled speed!

If the **ENABLE** command is active when switched on, the inverter will not start until terminal **MDI2** opens and closes again. This safety measure may be disabled in parameter **C181.**

If the **ENABLE** input is disabled when the inverter is controlling the motor, it is closed with a delay time depending on the inverter size. This **ENABLE** delay starts from the instant when the input is disabled regardless of the enabling delay (if any) set through a software timer in **MDI2**.

The operating mode and the logic used by the **ENABLE** input to enable/disable the inverter also depends on the programming of the **ENABLE–S** and **DISABLE** functions.

With the **IFD** control the inverter enabling is also dependent on the **START** input and on the current value of the active reference. If the **START** command is active but the reference is lower than a preset threshold, the inverter operation is inactive. To enable this operating mode with other types of control, it is necessary to set parameters **P065** and **P066** appropriately.
The **PID** regulator may also disable the inverter operation (see parameter **P255)**.

**CAUTION** If the **ENABLE** input signal is disabled for one of the active terminals, the inverter is instantly disabled and the motor starts idling! The motor could reach uncontrolled speed due to the mechanical load. In this case the mechanical load could bring about uncontrolled speed/shut down!

**CAUTION** If a protection/alarm trips, the inverter disables and the motor starts idling!

**NOTE** If software timers are enabled for digital inputs, the timer for the **ENABLE** signal (timer active for **MDI2**) delays the signal enabling. The **ENABLE** signal is always instantly disabled (*for the **ENABLE** function, Toff in **MDI2** is ignored*).

**NOTE** The activation of the **ENABLE** command enables the particular alarms which controls the configuration consistency of certain parameters.

**NOTE** When the **ENABLE** signal is shutdown it is impossible to modify the type parameters with the factory-setting. By setting the **P003** condition for modifying the C parameters = Standby+Fluxing, the parameters may be modified even if the inverter is enabled but the motor is not on.

**NOTE** When the **ENABLE** signal is shutdown for VTC and FOC controls the inverter fluxes the motor. It is possible to flux the motor only if the **START** is shutdown and **C184** = Yes is set.

### 28.1.3. RESET (TERMINAL 16:MDI3)

The **RESET** function is assigned to input terminal **MDI3**. It resets the alarms to unlock the inverter operation. It cannot be programmed on other terminals, but additional functions to the **RESET** function may be assigned to the same terminal.
To remove the reset function from the MDI3 set **C154** = Yes.
If a protection trips, the inverter locks, the motor starts idling (the motor idles and stops due to friction or the mechanical load) and an alarm message is displayed.

Reset procedure
To unlock the inverter, activate the **RESET** input for an instant, or press the **RESET** key on the keypad. When the inverter unlocks and the cause for the alarm has been removed, "Inverter OK" comes up on the screen, otherwise, the alarm persists and cannot be reset.
To restart the inverter with the factory-setting, activate and deactivate the **ENABLE** command (see parameter **C181**).

**NOTE**

The factory-setting does not reset alarms. The alarms are stored and displayed at next power on and by keeping the inverter locked. To reset unlock the inverter.
The alarms stored may be automatically reset at power on by setting special parameters (see the AUTORESET MENU).

**CAUTION**

If an alarm trips, see the section on ALARMS AND WARNINGS regarding the diagnostics. Reset the drive when the cause for the alarm has been removed.

**DANGER**

Electrical shock hazard exists on output terminals (U, V, W) and resistive braking module terminals (+, –, B) even when the inverter is disabled.

**NOTE**

To remove the reset function from the MDI3 set **C154** = Yes. If removed only one additional function can be allocated to MDI3 even with multiprogramming active (see **C182**).

## 28.2. Factory-setting of the Digital Inputs

Table 60: Terminal board: Factory-setting

| Function | Terminal | Description |
|---|---|---|
| START | 14: MDI1 | Enables the inverter RUN |
| ENABLE | 15: MDI2 | Enables the inverter |
| RESET | 16: MDI3 | Resets the alarms tripped |
| MULTISPEED 0 | 17: MDI4 | Bit 0 for Multispeed selection |
| MULTISPEED 1 | 18: MDI5 | Bit 1 for Multispeed selection |
| Source Sel | 19: MDI6 | Source Selection |
| Loc/Rem | 20: MDI7 | Local / Remote Control Selection |
| CwCCW | 21: MDI8 | Reference reversal |

## 28.3. List of Parameters C149a to C187

The parameters ranging from **C149a** to **C180** and from **C186** to **C187** (one for each command function) activate single functions and set the terminal for each enabling/disabling function.
Parameter **C181** enables a safe **START** mode.
Parameter **C182** enables multiple programming (if compatible) on the same terminal. In any case, a maximum of two functions are programmable on the same input.

Table 61: List of Parameters C149a ÷ C187

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| C149a | **START B** Input | ADVANCED | 1297 | none |
| C150 | **STOP** Input | ADVANCED | 1150 | none |
| C150a | **STOP B** Input | ADVANCED | 1298 | none |
| C151 | **REVERSE** Input | ADVANCED | 1151 | none |
| C151a | **REVERSE B** Input | ADVANCED | 1299 | none |
| C152 | **ENABLE–S** Input | ADVANCED | 1152 | none |
| C153 | **DISABLE** Input | ADVANCED | 1153 | none |
| C154 | **RESET** alarms on MDI3 disabled | ADVANCED | 1154 | NO |
| C155 | **MULTISPEED 0** Input | ADVANCED | 1155 | MDI4 |
| C156 | **MULTISPEED 1** Input | ADVANCED | 1156 | MDI5 |
| C157 | **MULTISPEED 2** Input | ADVANCED | 1157 | none |
| C158 | **MULTISPEED 3** Input | ADVANCED | 1158 | none |
| C159 | **CW/CCW** Input | ADVANCED | 1159 | MDI8 |
| C160 | **DCB** Input | ADVANCED | 1160 | none |
| C161 | **UP** Input | ADVANCED | 1161 | none |
| C162 | **DOWN** Input | ADVANCED | 1162 | none |
| C163 | **RESET UP/DOWN** Input | ADVANCED | 1163 | none |
| C164 | **External alarm 1** Input | ADVANCED | 1164 | none |
| C164a | **External alarm 1** trip delay | ADVANCED | 1305 | Immediate |
| C165 | **External alarm 2** Input | ADVANCED | 1165 | none |
| C165a | **External alarm 2** trip delay | ADVANCED | 1306 | Immediate |
| C166 | **External alarm 3** Input | ADVANCED | 1166 | none |
| C166a | **External alarm 3** trip delay | ADVANCED | 1307 | Immediate |
| C167 | **MultiRamp 0** Input | ENGINEERING | 1167 | none |
| C168 | **MultiRamp 1** Input | ENGINEERING | 1168 | none |
| C169 | **JOG** Input | ADVANCED | 1169 | none |
| C170 | **SLAVE** Input | ADVANCED | 1170 | none |
| C171 | **PID DISABLE** Input | ADVANCED | 1171 | none |
| C172 | **KEYPAD LOCK** Input | ADVANCED | 1172 | none |
| C173 | **MOTOR 2 SEL.** Input | ENGINEERING | 1173 | none |
| C174 | **MOTOR 3 SEL.** Input | ENGINEERING | 1174 | none |
| C175 | **SPEED VAR. 0** Input | ENGINEERING | 1175 | none |
| C176 | **SPEED VAR. 1** Input | ENGINEERING | 1176 | none |
| C177 | **SPEED VAR. 2** Input | ENGINEERING | 1177 | none |
| C178 | **PID RESET UP/DOWN** input | ADVANCED | 1178 | none |
| C179 | **SOURCE SELECTION** Input | ADVANCED | 1179 | MDI6 |
| C180 | **LOC/REM** Input | ADVANCED | 1180 | MDI7 |
| C180a | Type of **LOC/REM** contact | ADVANCED | 1303 | Pushbutton+Storage |
| C181 | Safety Start enabling | ADVANCED | 1181 | Inactive |
| C182 | Multiprogramming enabling | ENGINEERING | 1182 | Inactive |
| C183 | Fluxing max. time before inverter disabling | ADVANCED | 1183 | Disabled |
| C184 | Fluxing at activation only with **START** closed | ADVANCED | 1184 | no |
| C185 | Stop Mode | ADVANCED | 1185 | Deceleration Ramp |
| C186 | **Fire Mode enabling** Input | ENGINEERING | 1186 | none |
| C187 | **Torque limit source ref. disabling** Input | ADVANCED | 1187 | none |

NOTE

If a parameter is set to zero, its function is disabled, otherwise the parameter value stands for the MDIx input assigned to the function.

CAUTION

The setting of two functions on the same terminal is only possibly by enabling the **C182=1** parameter.

C149a START B Input

| C149a | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1297 | |
| | Function | The **START B** Input acts as the **START** Input (see paragraph START (terminal 14:MDI1)) when Terminal Board B is active. | |

C150 STOP Input

| C150 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1150 | |
| | Function | This parameter disables the **RUN** function enabled by the **START** command.<br><br>The setting of this function has effect on the enabling/disabling mode of the **RUN** command: it can be enabled/disabled using the **START and STOP keys** or the **START, STOP and REVERSE keys** instead of the **START** key as **an ON/OFF switch** (factory-setting).<br><br>If the inverter is enabled:<br>Press **START** to enable the inverter **RUN;**<br>Press **STOP** to disable the inverter **RUN**: reference is set to zero, so the speed (or torque) setpoint decreases to zero based on the preset deceleration ramp.<br><br>In case of preset **STOP**, the keypad and one or more terminal boards may be enabled at a time. In this case, the ***START*** key and the ***STOP*** key in the display/keypad are active and can enable or disable the inverter **RUN**.<br><br>The **STOP** is a normally closed input signal. | |

NOTE

With the factory setting only the hardware terminal board selected with command source 1 (**C140**=1) is active with the switch-operated mode (**C150**=0).
To switch to the key-operated mode, set the **STOP** input (**C150** ≠0). The keypad and other terminal boards may be selected in key-operated mode only.
If the **STOP** input is not programmed, and the switch-operated mode is active, the keypad may be selected as the only command source (**C140**=5, **C141**=0, **C142** =0).

NOTE

The **STOP** function has priority over the **START** function; if both inputs are active, the **STOP** input prevails. Therefore the **STOP** input acts as a key and as a **switch**.

NOTE

When the inverter is disabled, the **STOP** button, the **START** button and the ***START key*** and the ***STOP key*** in the display/keypad are ignored.

C150a STOP B Input

| C150a | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1298 | |
| | Function | The **STOP B** Input acts as the **STOP** Input (see **C150**) when Terminal Board B is active.<br><br>The **STOP B** is a normally closed input signal. | |

C151 REVERSE Input

| C151 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1151 | |
| | Function | The **REVERSE** function carries out a **START** command, but it reverses the motor direction of rotation.<br>If both the **START** and **REVERSE** inputs are active at the same time: the inverter is sent a STOP command.<br>If the **STOP** input function is not programmed (**C150**=0) the **REVERSE** signal and the **START** input act as switches, otherwise they act as keys. | |

NOTE

If the keypad is active, pressing the **FWD/REV** key on the display/keypad will also reverse the direction of rotation of the connected motor.
The reference direction of rotation can be reversed with **Cw/CCw** if this is set as well (**C159** ≠ 0).
Both functions bring about an inversion of the signal; if both are active they are both cancelled reciprocally.

NOTE

The contemporary enabling of the keypad and terminal is possible only if the **STOP** (**C150** ≠ 0) function is activated. In this case the inversion sources may be three: **REVERSE**, **Cw/CCw**, ***REV*** key, if two are active they are cancelled reciprocally, if three active there is an inversion.

CAUTION

When the reference sign is reversed, the direction of rotation of the connected motor is not immediately reversed: the setpoint decreases to zero following the preset deceleration ramp, and it increases up to the reference value having the opposite sign following the preset acceleration ramp.

C151a REVERSE B Input

| C151a | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1299 | |
| | Function | The **REVERSE B** Input acts as the **REVERSE** Input (see **C151**) when Terminal Board B is active. | |

Figure 36 illustrates the logic diagram for processing the **START**, **REV**, **Cw/CCw** functions and the ***START, STOP, REV*** keys on the display/keypad if the **STOP** function is not programmed.

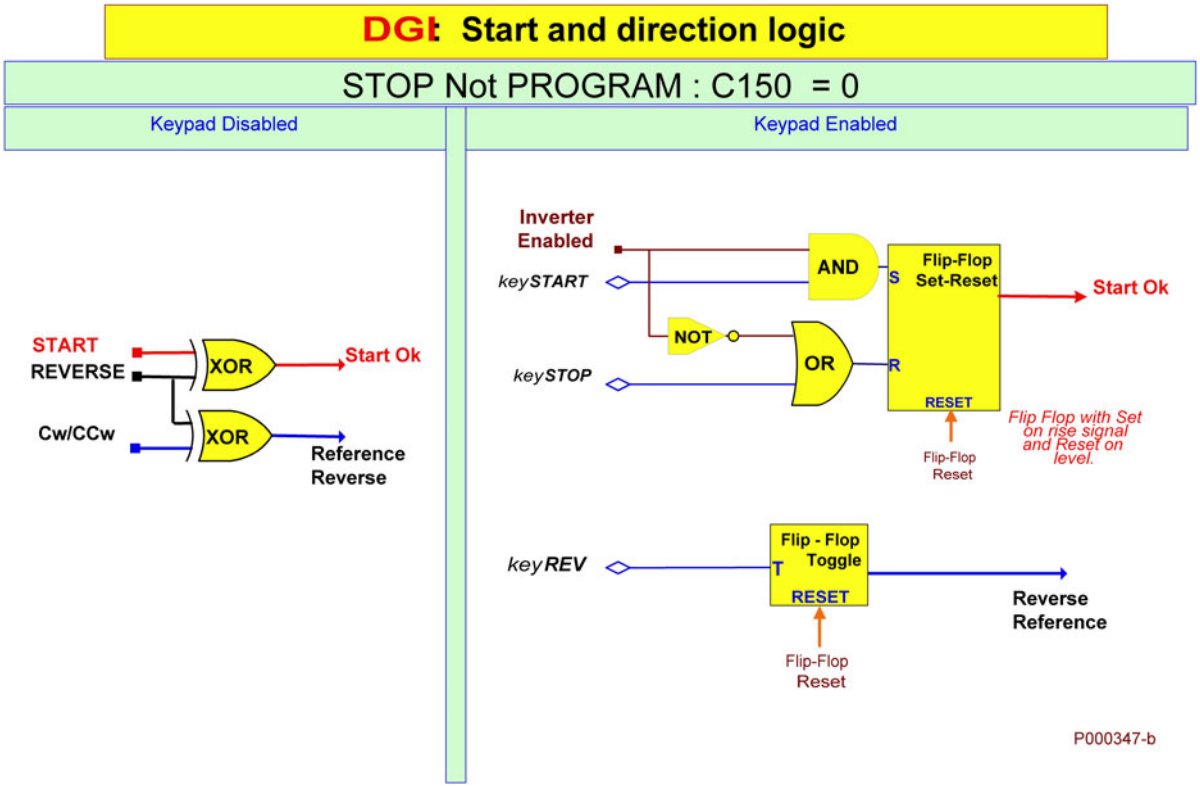



**Figure 36: Controlling Run and Direction when STOP Input is not programmed.**

Figure 37 illustrates the processing logic diagram of the **START**, **REV, Cw/CCw** functions and of the ***START, STOP, REV keys*** on the display/keypad, if the **STOP** function is set up.

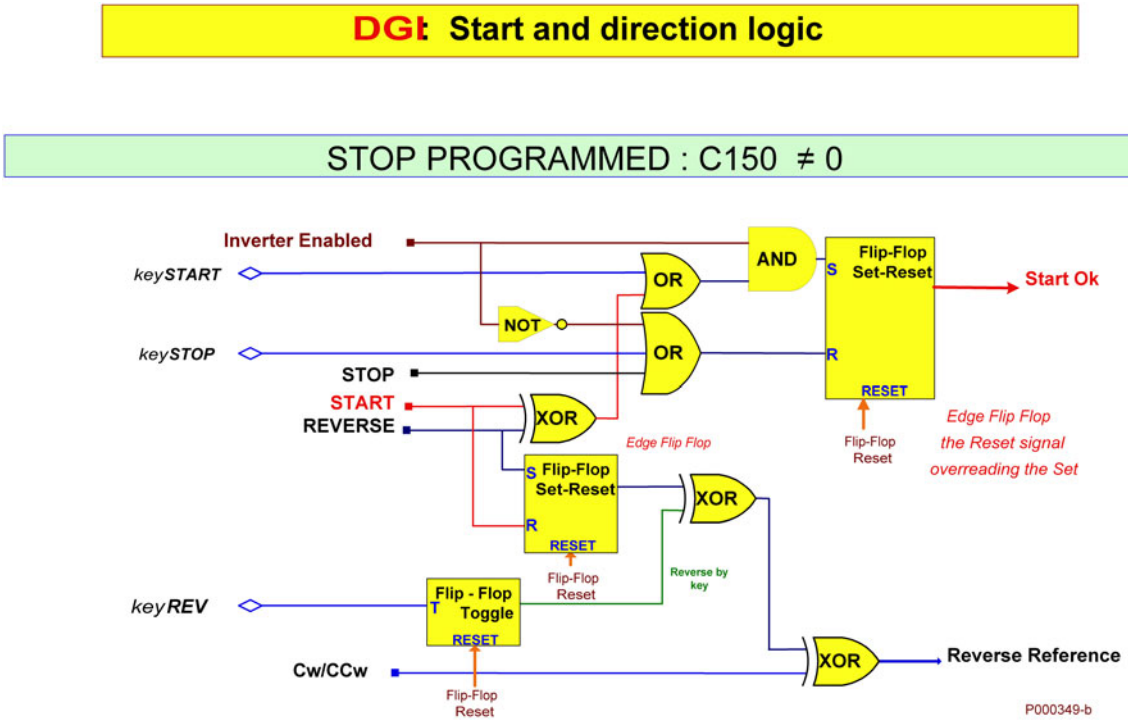



**Figure 37: Controlling Run and Direction when STOP Input is programmed.**

C152 ENABLE–S Input

| C152 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1152 | |
| | Function | This is a safety ENABLE: if this function is enabled, the inverter activates only if both **ENABLE** and **ENABLE–S** inputs are active. | |

NOTE

The **ENABLE–S** signal cannot be delayed by software timers: if a timer is programmed for the terminal relating to **ENABLE–S**, it will have no effect on the **ENABLE–S** function, whereas it will normally delay other functions programmed for the same terminal.

C153 DISABLE Input

| | | | |
|---|---|---|---|
| C153 | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1153 | |
| | Function | The **DISABLE** function disables the inverter and overrides any eventual **ENABLE** signals.<br>The **DISABLE** command sets to zero the inverter output voltage, so the motor starts idling (the motor idles and stops due to friction or the mechanical load).<br>If the **DISABLE** function is set (**C153**≠0) to activate the inverter, deactivate the input signal on the terminal selected with **C153** to enable the inverter; then activate the **ENABLE** function (and the **ENABLE–S** function, if programmed). | |

C154 RESET alarms on MDI3 disabled

| | | | |
|---|---|---|---|
| C154 | Range | 0 ÷ 1 | 0 :NO ; 1: Yes |
| | Default | 0 | 0: NO |
| | Level | ADVANCED | |
| | Address | 1154 | |
| | Function | With **C154** =1 : Yes it is possible to disactivate the reset alarms function from MDI3. | |

C155, C156, C157, C158 MULTISPEED Inputs

| | | | |
|---|---|---|---|
| C155<br>C156<br>C157<br>C158 | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | **C155** = 4, **C156** = 5,<br>**C157** = 0, **C158** = 0. | **C155** = MDI4, **C156** = MDI5,<br>**C157** = Inactive, **C158** = Inactive. |
| | Level | ADVANCED | |
| | Address | 1155, 1156, 1157, 1158 | |
| | Function | This function generates up to 15 speed references that can be programmed with parameters **P081÷P098** according to the programming mode set in **P080**.<br><br>The 4 Multispeed functions determine which of the 15 the active speed references are active: active value (**1**) or inactive value (**0**) of each preset input signal determines a bit-logic binary number: **MULTISPEED 0** is the less significant bit (bit 0) and **MULTISPEED 3** is the most significant bit (bit 3) as stated in Tables 5 and 6.<br><br>If one of these functions is not set, its relative bit is “zero”. | |

**Table 62: Multispeed Selection**

| Multispeed selected = | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|
| | **MULTISPEED 3** | **MULTISPEED 2** | **MULTISPEED 1** | **MULTISPEED 0** |

Table 63: Selected Speed reference

| Function: | Status of the relative input | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| START | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MULTISPEED 0 | X | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| MULTISPEED 1 | X | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| MULTISPEED 2 | X | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| MULTISPEED 3 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Multispeed selected* | *X* | *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* | *13* | *14* | *15* |
| Resulting reference | 0 | (*) | P081 | P083 | P085 | P087 | P088 | P089 | P090 | P091 | P092 | P093 | P094 | P095 | P096 | P097 | P098 |

If one of these functions is not set, its relative bit value is "zero".
For example, if **C156** and **C157** are Inactive (0), while **C155** and **C158** are programmed on two different terminals, only Multispeed 0, 1, 8, 9 can be selected, relating to the following references:

| (*) | P081 | P091 | P092 |
|---|---|---|---|

(*) With the factory-setting: (**P080** = ***Preset Speed***), if no Multispeed function is selected, the active reference **is** the reference set according to the parameters in the References Menu.
If **P080** = ***Speed Sum***, the selected Multispeed function **adds up** to the active : the reference set according to the parameters of the References Menu.

If **P080** = ***Preset Speed Esc***, the selected Multispeed **replaces** the active reference, which will be ignored. If no Multispeed function is selected, the resulting reference is equal to zero.
See also the INPUT REFERENCES MENU for the reference processing sequence: the **Speed Decrease** function and the **Reference Reversal** function become active downstream of the **Multispeed** function.

NOTE

In Table 63
0 ⇒ input Inactive;
1 ⇒ input Active;
X ⇒ input having no effect.

C159 Cw/CCw Input

| C159 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 8 | MDI8 |
| | Level | ADVANCED | |
| | Address | 1159 | |
| | Function | The **Cw/CCw** function reverses the **active reference signal**: the connected motor: decelerates to zero following the preset deceleration ramp, then it accelerates following the preset acceleration ramp until it reaches the new reference value. | |

C160 DCB Input

| C160 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1160 | |
| | Control | IFD and VTC | |
| | Function | For other types of control, this function has no effect even if **C160**≠0.<br>The DCB command enables **DC braking** for a period of time depending on the speed value determining the input activation.<br>See DC BRAKING MENU for more details. | |

C161, C162 UP and DOWN Inputs

| C161 C162 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1161, 1162 | |
| | Function | This function increases (**UP**) or decreases (**DOWN**) the reference for which the **UpDown source from MDI has been selected** by adding a quantity to the reference itself.<br>This also depends upon the following parameters:<br>**C163** Up/Down Reset<br>**P067** Up/Down Ramp Time<br>**P068** Memorise Up/Down value when power off<br>**P068a** Up/Down Reset Speed/Torque at stop<br>**P068b** Up/Down Reset PID at stop<br>**P068c** Up/Down Reset Speed/Torque at when sources changed<br>**P068d** Reset Up/Down PID when sources changed<br>**P069** Up/Down Range Reference | |

C163 Up/Down Reset Input

| C163 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1163 | |
| | Function | This function sets to zero the **variation** of reference obtained with the **UP** or **DOWN** inputs or with the keys ▲ and ▼ on the keypad/display. The Up/Down reset reference may also be carried with other functions (see **P068a – P068d**). | |

## C164 (C165, C166) External Alarm Inputs

| | | | |
|---|---|---|---|
| C164<br>C165<br>C166 | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1164, 1166, 1166 | |
| | Function | By programming a digital input with one of these 3 functions the status of this input will **ALWAYS AND ONLY BE DISPLAYED ON THE INVERTER'S TERMINAL BOARD**.<br>When the command contact opens the inverter is blocked by an alarm.<br>A delay of the external alarm operations can be set with the relative parameters **C164a, C165a, C166a**.<br>To restart the inverter, the digital input set as an external alarm must be closed and it is necessary to perform a reset procedure.<br>Alarms generated by these 3 functions are respectively: **A083**, **A084**, **A085**.<br>With a factory-setting this function is disabled. | |

**CAUTION**

The terminal board for these 3 functions is only the terminal hardware of the inverter. If different command sources are enabled (see CONTROL METHOD MENU), the "External Alarm" signal command is obtained only for the inverter's terminal hardware. Therefore, in order to avoid any relative external alarm, the input signal for the active terminal must have an input signal on the terminal board.
The alarm trips when only one input signal for the terminal selected on one of the active command sources is disabled. An alarm trip delay can be programmed with the relative parameters **C164a, C165a, C166a.**

## C164a (C165a, C166a) External Alarm Trip delays

| | | | |
|---|---|---|---|
| C164a<br>C165a<br>C166a | Range | 0 ÷ 32000 | 0 ÷ 32000 msec |
| | Default | 0 | Immediate |
| | Level | ADVANCED | |
| | Address | 1305, 1306, 1307 | |
| | Function | External alarm trip delay. To avoid untimely alarm trip, it may be necessary to set a check time for the opening of the input set as an external alarm before the alarm trips. | |

C167, C168 MULTIRAMP Inputs

| C167 C168 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ENGINEERING | |
| | Address | 1167, 1168 | |
| | Function | This function allows to select up to **4 acceleration/deceleration ramps**. Each ramp has its own programming parameters see **P009 ÷ P025** ( RAMPS MENU)<br>These 2 functions determine which of the 4 ramps is to be selected: the active value (**1**) or inactive value (**0**) of each preset input signal determines a binary number with a bit-logic, where **Multiramp 0** is the less significant bit (bit 0 ) and **Multiramp 1** is the most significant bit (bit 1), as stated in Tables 61 and 62.<br>**The ramps range from 1 to 4, for the selected ramp, add 1 to the binary figure obtained.**<br>If one of these functions is not programmed, the value of the relative bit is "zero". | |

**Table 64: Multiramp selection**

| Selected Ramp = ( | Bit 1 | Bit 0 | ) + 1 |
|---|---|---|---|
| | **Multiramp 1** | **Multiramp 0** | |

**Table 65: Selected Ramp**

| Function: | Input Status | | | |
|---|---|---|---|---|
| Multiramp 0 | 0 | 1 | 0 | 1 |
| Multiramp 1 | 0 | 0 | 1 | 1 |
| *Selected Ramp* | *1* | *2* | *3* | *4* |
| Active ramp times (parameters determining the ramp model) | **P009 P010 P014 (*)** | **P012 P013 P014 (*)** | **P015 P016 P020 (*)** | **P018 P019 P020 (*)** |

If one of these functions is not programmed, the value of the relative bit is "zero".
For example, if **C167** is Inactive (0) and **C168** is programmed for one terminal, it is therefore possible to select only ramp **1** or ramp **4**.

NOTE (*)

If the ramp rounding off function is enabled (**P021**≠0), the real ramp times also depend on the values of parameters **P022**, **P023**, **P024**, **P025**, **P031**.

## C169 JOG Input

| C169 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1169 | |
| | Function | When the JOG function is enabled, the motor rotates at low speed with slow ramps manually controlled by the user only by means of the key.<br>If the inverter is enabled (**ENABLE** activated) but is not running, and if the terminal is enabled, the inverter will run: the connected motor will accelerate with a JOG ramp (**P029**) up to the JOG speed reference (**P070**). On the other hand, if the terminal is disabled, the inverter will stop: the connected motor will decelerate to zero speed following the JOG ramp (**P029**).<br>Reverse the direction of rotation of the active reference to reverse the **JOG** reference. | |

CAUTION

The activation of this terminal determines the motor to **RUN** (if the inverter is enabled).

NOTE

The **RUN** function will override the **JOG** function.
Therefore, if the **RUN** function is active, the **JOG** function is ignored.

NOTE

In the ***SLAVE* mode** (torque reference instead of speed reference) if the motor is not running, it can rotate at JOG speed by enabling the **JOG** function.
In **SLAVE mode**, the **JOG** function is ignored if the motor is still rotating for an active reference torque.

## C170 SLAVE Input

| C170 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1170 | |
| | Control | VTC and FOC | |
| | Function | By activating the relative programmed terminal this function makes the main reference become a **torque reference,** completely bypassing the speed loop.<br>This function enables the *SLAVE* operating mode (**torque reference**), instead of the *MASTER* operating mode (speed reference) and in this case the Torque References and the Torque Ramps are used (**References Menu** and **Ramps Menu**). | |

NOTE

This function is ignored if the operating mode selected for the active motor is the *SLAVE* mode, i.e. **C011**=1 (motor 1), **C054**=1 (motor 2), **C097**=1 (motor 3).
With factory-setting the commands are set in *MASTER* mode and the speed reference is selected; ( **C011**= 0 ; **C054** =0 ; **C097** = 0)

CAUTION

It is possible to switch from *MASTER* to *SLAVE* mode (or vice versa) only when the inverter is disabled.

C171 PID DISABLE Input

| C171 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1171 | |
| | Function | This function is used for managing the PID regulator (see PID CONFIGURATION MENU).<br>By activating the relative set terminal, this function makes it possible to disable the PID regulator: its output and its external variable are set to zero.<br>More precisely, if the PID regulator is in **External Out** mode (**C294**=0), when the **PID DISABLE** function is enabled, the PID output is set to zero and the external variable regulated by the PID regulator (feedback) is no longer regulated by the PID regulator itself.<br>In the Reference mode, therefore, the **PID DISABLE** function disables the PID regulator as described above and **commutates the reference,** thus becoming the main active reference again. | |

C172 KEYPAD LOCK Input

| C172 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1172 | |
| | Function | This function **avoids accessing parameter modification** through the remotable display/keypad and **avoids accessing the *LOCAL mode*** by pressing the ***LOC/REM key*** or by enabling the **LOCAL** input function **(C181).** | |

NOTE

If the ***LOCAL*** mode is already active, the **LOCK** command will have no effect on the ***LOCAL*** function: it only avoids altering the programming parameters, while it is still possible to send references and the ***START/STOP/REV/JOG/RESET*** commands via keypad.
If the **LOCK** command is active and the ***LOCAL mode*** is disabled, the **LOCK** function prevents the activation of the LOCAL mode.

C173 MOTOR 2 SEL Input

| C173 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ENGINEERING | |
| | Address | 1173 | |
| | Function | This function **activates motor 2** and sets the programming parameters for motor 2, see Table 66.<br>The active motor may be changed only when the inverter is disabled. | |

C174 MOTOR 3 SEL. Input

| C174 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ENGINEERING | |
| | Address | 1174 | |
| | Function | This function **activates motor 3** and sets the programming parameters for motor 3, see Table 66.<br>The active motor may be changed only when the inverter is disabled. | |

NOTE By enabling both inputs, Motor 1 is again selected.

Table 66: Motor Selection

| Terminal Selecting the **Motor 2 Sel.** Function (**C173**) | Terminal Selecting the **Motor 3 Sel.** Function (**C174**) | Active Motor |
|---|---|---|
| 0 | 0 | Mot or 1 |
| 1 | 0 | Motor 2 |
| 0 | 1 | Motor 3 |
| 1 | 1 | Motor1 |

C175, C176, C177 SPEED VAR. Inputs

| C175 C176 C177 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ENGINEERING | |
| | Address | 1175, 1176, 1177 | |
| | Function | This function generates up to 7 values of variation % for the active reference ranging from –100% to 100% with parameters **P115÷P121**. The 3 functions determine which of the 7 values of the speed reference variation is active: the active value (**1**) or inactive value (**0**) of each preset input signal determines a bit-logic binary number where **SPEED VAR. 0** is the less significant bit (bit 0), while **SPEED VAR. 2** is the most significant bit (bit 3) as shown in Tables 64 and 65. If one of these functions is not set, the relative bit is "zero". | |

Table 67: Selection of the Speed Reference Variation

| Variation of the Selected Speed Reference = | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|
| | SPEED VARIATION 2 | SPEED VARIATION 1 | SPEED VARIATION 0 |

Table 68: Variation of selected Speed Reference

| Function: | Input Status | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MULTISPEED 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| MULTISPEED 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| MULTISPEED 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| *Variation of the selected speed reference* | *None* | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
| Variation % selected | 0 | P115 | P116 | P117 | P118 | P119 | P120 | P121 |

If one of the functions above is not set, its relative bit is zero.
For example, if **C175** and **C177** are INACTIVE (0) and **C176** is programmed for one terminal, only variation 2 corresponding to parameter **P116** can be selected.
In any case, the output speed must never exceed the max. allowable speed, even when a higher speed is required.

NOTE In Table :
0 ⇒ Inactive Input;
1 ⇒ Active Input.

C178 PID Up/Down Reset Input

| C178 | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
|---|---|---|---|
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1178 | |
| | Function | This function **resets the variation of the PID reference** obtained with the ▲ and ▼ keys on the KEYPAD page of the user interface on the display/keypad in PID mode. | |

C179 Source Selection Input

| C179 | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
|---|---|---|---|
| | Default | 6 | MDI6 |
| | Level | ADVANCED | |
| | Address | 1179 | |
| | Function | The digital input set as a source selector is **considered only in the inverter's terminal board.**<br>By setting a digital input as a source selector, when this is not active (MDI corresponding to open terminal board) only the first command sources and set references are taken into consideration (**C140** command source no. 1 and **C143** reference source no.1 respectively). With the MDI set in **C179** closed the first command and reference sources are ignored (**C140** and **C143**) whilst only the second command source and the second reference source (**C141** command source no. 2 and **C144** reference source no.2 respectively) are considered. | |

CAUTION

If set different to 0:Disabled the reference sources no. 3 and no. 4 (**C145** and **C146** respectively) are always considered as the sum of the one selected by the selector (MDI open → **C143** / MDI closed **C144**)

C180 LOC/REM Input

| C180 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 7 | MDI7 |
| | Level | ADVANCED | |
| | Address | 1180 | |
| | Function | The **LOCAL mode** can be enabled from the relative digital input (it ignores the enabling/disabling delays set by the software timers) or also by the ***LOC/REM*** key on the keypad/display.<br>With the factory-setting this may be activated only when the inverter is disabled. To change the settings see **C148 Changeover from remote to local command** with which it is possible to choose whether the changeover from remote to local and vice versa may also be carried out during RUN and if sent to the Local mode the RUN or Reference state is to be maintained. This function makes it possible to changeover to the LOCAL mode, that is bypass what has been set with the parameters **C140**, **C141**, **C142**, **C143**, **C144**, to ignore the digital command sources and the references, **where all can be set only from the KEYPAD.**<br>The following functions however, remain active on the hardware terminal board; **ENABLE**, **External Alarm 1, 2, 3, Motor 2 Sel., Motor 3 Sel., SLAVE, PID, Disable** and the actual **LOCAL function**, in order to allow the disabling of the modes.<br>Deactivate the Local input when the inverter is disabled to reactivate signals coming from other command sources.<br>If the inverter's main reference is the PID output it may be useful to set the **C180a Contact Type for MDI Loc/Rem = Pushbutton** and **P266 Keypad type page in Local mode = Ref. Active + Speed.** In this way at the first **Loc** command edge the inverter is sent into the local mode and it will be possible to change the PID reference, whilst at the second edge of the **Loc** command (only if the inverter is disabled) the PID is disabled and it is possible to make reference to the motor in RPM (see also **C180a** in the CONTROL METHOD MENU and **P266** in the paragraph Keypad and Local Mode Page). | |

C180a Type of LOC/REM contact

| C180a | | | |
|---|---|---|---|
| | Range | 0 ÷ 2 | 0:[Switch],<br>1:[Pushbutton], 2:[Pushbutton+Storage] |
| | Default | 2 | 2:[Pushbutton+Storage] |
| | Level | ADVANCED | |
| | Address | 1303 | |
| | Function | With the factory-setting the digital contact set as LOC/REM (**C180**) is Pushbutton based.<br>When the main reference is the PID output and the **P266 Local Keypad type page = Ref.active + Speed** mode is desired that at the first LOC/REM contact sends to the LOCAL mode by setting the PID reference, and at the second command makes it possible to remain in the LOCAL mode, overriding the PID and making it possible to set the Speed reference directly; to do this the LOC/REM digital input must by a **C180a=Pushbutton**.<br>Selecting **C180a=2**, the logical status of **LOC/REM** will be stored at power off and used at the next power on of the inverter. | |

C181 Safety Start

| C181 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | Inactive, Active |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1181 | |
| | Function | This function **enables** the ***Safety START mode***.<br>When this function is enabled and the inverter is to be restarted after resetting an alarm, open and close the **ENABLE** terminal.<br>This mode avoids the inverter to RUN when not desired, when the inverter is turned off and on again (for example after a mains loss) and the **START** and **ENABLE** inputs are on. | |

NOTE If multiple terminal boards are selected with parameters **C140**, **C141**, **C142**, simply open and close the **ENABLE** terminal (**MDI2**) in one of the active terminal boards to restart the inverter.

C182 Multiprogramming enabling

| C182 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | Inactive, Active |
| | Default | 1 | Inactive |
| | Level | ENGINEERING | |
| | Address | 1182 | |
| | Function | With this function 2 programs may be set for the same terminal: not all combinations are possible.<br>For each function to be enabled the software will refuse illegal configurations by displaying "ILLEGAL DATA" when attempting to enter a new illegal value. | |

C183 Fluxing max. time before inverter disabling

| C183 | | | |
|---|---|---|---|
| | Range | 0 ÷ 65000 | 0 ÷ 65000 ms |
| | Default | 0 | Disabled |
| | Level | ADVANCED | |
| | Address | 1183 | |
| | Control | VTC and FOC | |
| | Function | This function disables the inverter if the fluxing time period is longer than the time set (if **ENABLE** is closed, but not **START**).<br>To restore motor fluxing, disable and enable the **ENABLE** command, or send a **START** command when **ENABLE** is closed. | |

NOTE This time is added to Fluxing ramp time **C041** / **C084** / **C127**.

C184 Fluxing at activation only with START closed

| C184 | | | |
|---|---|---|---|
| | Range | 0-1 | 0:No – 1:Yes |
| | Default | 0 | 0:No |
| | Level | ADVANCED | |
| | Address | 1184 | |
| | Control | VTC and FOC | |
| | Function | Fluxing may be carried out only when the **START** command is closed. | |

C185 STOP Mode

| C185 | | | |
|---|---|---|---|
| | Range | 0-1 | 0: [Deceleration Ramp] – 1:[Idling] |
| | Default | 0 | 0: [Deceleration Ramp] |
| | Level | ADVANCED | |
| | Address | 1185 | |
| | Function | This function makes it possible to select whether the inverter is to be deactivated with a controlled deceleration ramp or idling when the **START** command is open. | |

C186 Fire Mode enabling Input

| C186 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ENGINEERING | |
| | Address | 1186 | |
| | Function | It is possible to set a digital input to activate the Fire Mode (see section 4.12). | |

.

C187 Digital Input for disabling torque limit source ref.

| C187 | | | |
|---|---|---|---|
| | Range | 0 ÷ 8 | Inactive, MDI1 ÷ MDI8 |
| | Default | 0 | Inactive |
| | Level | ADVANCED | |
| | Address | 1187 | |
| | Function | This function sets a digital input for disabling the limit of the external torque. When the digital input set for **C187** is active, the torque limit will be based upon the parameters of the LIMITS MENU when the motor is running. | |

# 29. ENCODER/FREQUENCY INPUTS MENU

## 29.1. Overview

Three quick acquisition digital inputs are available in the Sinus Penta control board:
• MDI6/ECHA/FINA;
• MDI7/ECHB;
• MDI8/FINB;
which can be used as encoder reading (encoder A) or as frequency inputs. In addition, by using optional board ES836 (see the Sinus Penta **Installation Instructions** manual), an additional encoder can be connected (encoder B).

NOTE If **MDI6** and **MDI7** are used for encoder reading, only Push–Pull encoders can be used.

NOTE For the reversal of the encoder speed measure, properly set up parameter **C199**.

### 29.1.1. WITHOUT OPTIONAL BOARD ES836

• **Encoder reading**:
Digital inputs **MDI6** and **MDI7** are used for reading the two channels of a 24V push–pull encoder powered directly by the encoder board (see the Sinus Penta **Installation Manual**).
No function can be programmed for **MDI6** and **MDI7**; if you attempt to program **MDI6** and **MDI7,** alarm **A082** Illegal Encoder Configuration will trip when **ENABLE** closes.
• **Reading a Frequency Input**:
Digital input **MDI6** or **MDI8** can be used.
If **MDI6** is programmed as a frequency input (**FINA**) with **C189**, no other function must be programmed; otherwise, alarm **A100** MDI6 Illegal Configuration trips when **ENABLE** closes.
If **MDI8** is programmed as a frequency input (**FINB**) with **C189**, no other function must be assigned, and encoder optional board ES836 must not be applied to the power drive, otherwise, alarm **A101** MDI8 Illegal Configuration trips when **ENABLE** closes.
• **Reading a Frequency Input and an Encoder**:
**MDI6** and **MDI7** are used to read the push–pull encoder, and **MDI8** is used to read the frequency input. The following alarms may trip:
• **A082** Illegal Encoder Configuration, if additional functions are programmed for **MDI6** or **MDI7**;
• **A101 MDI8** Illegal Configuration, if additional functions are programmed for **MDI8** or if the power drive detects the presence of optional board ES836.

### 29.1.2. WITH OPTIONAL BOARD ES836

• **Reading 1 or 2 Encoders:**
To read one Encoder, use optional board ES836 or digital inputs **MDI6** and **MDI7** (if a push–pull encoder is used).
It is possible to use both the optional board and digital inputs **MDI6** and **MDI7** to read two encoders at a time. Use parameter **C189** to set the reading of the speed measure of the controlled motor or to read values as a reference.
You can use encoder **A** or encoder **B** as a speed feedback or as a reference source (speed reference, torque reference or PID reference).

Example:
If you want to use encoder **A** as a speed reference source and encoder **B** as a speed feedback, set **C189** as 6:[A Ref ; B Fbk]; use **P073** and **P074** (**References Menu**) to define the min. speed and the max. speed read for scaling and saturation of encoder **A** selected as a reference source (in one of parameters **C144** ÷ **C147**, Control Method Menu); set parameter **C012** (motor 1) to [Yes] to enable the Speed Feedback from Encoder function.
If encoder A is selected, it is not possible to program any function for **MDI6** and **MDI7**; otherwise, alarm **A082** Illegal Encoder Configuration will trip when **ENABLE** closes.
If encoder B is selected and optional board ES836 is not detected by the inverter, alarm **A082** Illegal Encoder Configuration will trip when **ENABLE** closes.

- Reading a Frequency Input:

Only digital input **MDI6** (FINA) can be used as a frequency input; if **MDI8** is programmed as a frequency input (FINB) with **C189**, if the optional board is installed, alarm **A101 MDI8** Illegal Configuration trips.
No additional function must be assigned to **MDI6**; otherwise, alarm **A100 MDI6** Illegal Configuration will trip when **ENABLE** closes.

- Reading a Frequency Input and an Encoder:

Digital input **MDI6** (FINA) is used as a frequency input and Encoder B is used (because reading frequency input FINB with MDI8 is not possible due to the installation of optional board ES836).
If additional functions are programmed for digital input **MDI6**, alarm **A100 MDI6** Illegal Configuration will trip when **ENABLE** closes.
If alarm **A082** Illegal Encoder Configuration trips, this means that the inverter did not detect optional board ES836 (check the board wiring).
Parameter **C189** defines whether quick acquisition digital inputs are used to read a frequency input or an encoder, and if the encoder is a reference source or a feedback source.
In the **Encoder Menu**, you can also do the following:

- define the number of pls/rev for the encoder being used;
- enable or disable the speed alarm;
- define a time constant applied to reading filtering;
- define whether encoders are read by means of squaring channels or by channel A only, letting channel B define the direction of rotation (ChB low level → negative rotation; ChB high level → positive rotation).

### 29.1.3. USING TWO ENCODERS

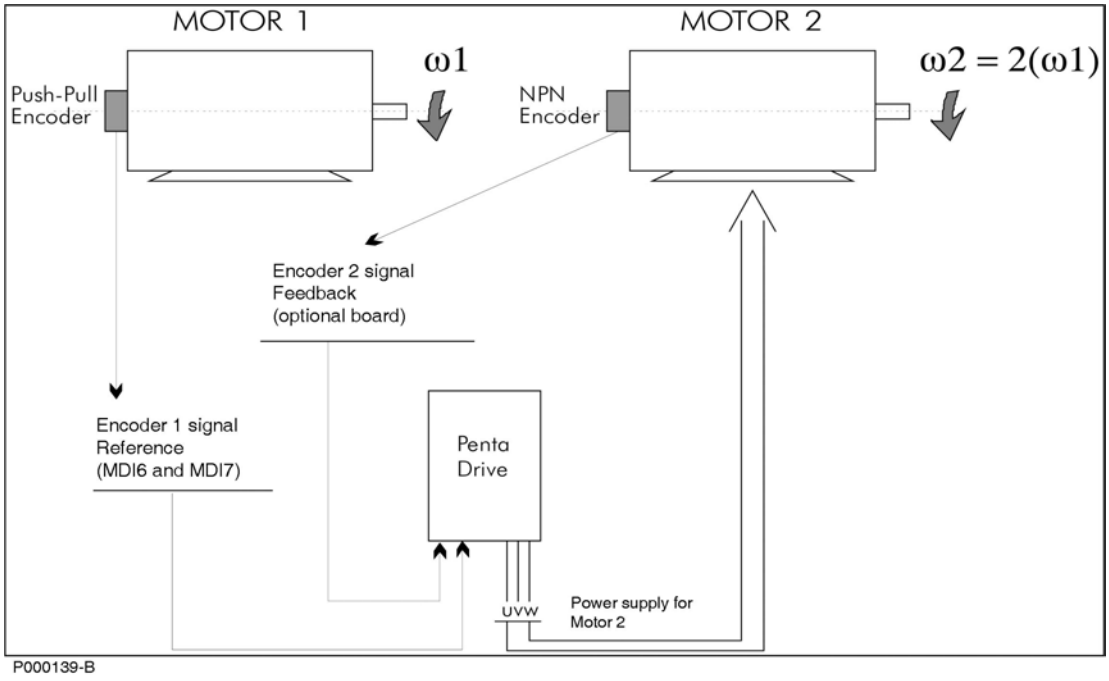



**Figure 38: Using Two Encoders (Example)**

Suppose that motor 2 is to be controlled in closed chain and that its speed value is twice the speed value of motor 1.
To do so, use speed of motor 1, provided with an encoder, as the reference for Penta Drive, and use the speed measure of encoder B, coaxial to the motor controlled by the inverter, as a speed feedback.
Suppose that motor 1 speed ranges from 0 to 750rpm and that motor 1 is provided with a Push–Pull encoder with Single–Ended outputs and that its resolution is 2048 pls/rev.

Motor 2 is provided with an NPN encoder with Single–Ended outputs; its resolution is 1024 pls/rev.
Only one Push-Pull encoder can be connected to digital inputs MDI6-MDI7, so encoder NPN of motor 2, representing the speed feedback of the drive, must be connected to optional board ES836 (inverter Encoder B), whereas the encoder of motor 1 (Push–Pull), used as a reference, shall be connected to terminals MDI6 and MDI7 (inverter Encoder A).
Encoder Configuration is as follows:

### Encoder/Frequency Inputs Menu

(operating modes and encoder features setting)

| | | |
|---|---|---|
| **C189** = | [6: A–Reference B–Feedback] | (Encoder/Frequency input operating mode) |
| **C190** = | 2048 pls/rev | (Number of pls/rev for Encoder A) |
| **C191** = | 1024 pls/rev | (Number of pls/rev for Encoder B) |
| **C197** = | [0: 2Ch.Quad.] | (Number of channels of Encoder A) |
| **C198** = | [0: 2Ch.Quad.] | (Number of channels of Encoder B) |
| **C199** = | [0: Fdbk.No Ref.No] | (Encoder reading sign reversal) |

### Motor Control 1 Menu

(Setup of control mode with speed feedback from encoder and min. speed and max. speed of the controlled motor)

| | | |
|---|---|---|
| **C012 =** | [Yes] | (Speed feedback from M1 encoder) |
| **C028 =** | 0 rpm | (Min. speed of motor M1) |
| **C029 =** | 1500 rpm | (Max. speed of motor M1) |

### Control Method Menu

(Setup of the source of the speed feedback from encoder)

| | | |
|---|---|---|
| **C143 =** | [8: Encoder] | (Selection of reference 1 source) |
| **C144 =** | [0: Disable ] | (Selection of reference 2 source) |
| **C145 =** | [0: Disable ] | (Selection of reference 3 source) |
| **C146 =** | [0: Disable ] | (Selection of reference 4 source) |

### References Menu

(Setup of the reading range for the encoder used as a speed reference)

| | | |
|---|---|---|
| **P073** = | 0 rpm | (Encoder input min. rpm) |
| **P074** = | 750 rpm | (Encoder input max. rpm) |

### Ramps Menu

(Ramps time applied to the reference are reset to maintain the desired speed variation without entering any delay value)

| | | |
|---|---|---|
| **P009** = | 0 | (Acceleration time 1) |
| **P010** = | 0 | (Deceleration time 1) |

When motor 1 reaches its max. speed (750rpm), the speed reference is 100% (because the speed value read by the encoder used as a reference source is saturated and scaled with respect to the min. rpm and max. rpm set in P073, P074). Because the max. speed of the motor controlled by the inverter is 1500 rpm (C029), the speed reference is 1500 rpm.

## 29.2. List of Parameters from C189 to C199

Table 69: List of Parameters C189 ÷ C199

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C189 | Encoder/Frequency input operating mode | BASIC | 1189 | 0 [Not used, Not used] |
| C190 | Number of pls/rev for encoder A | BASIC | 1190 | 1024 |
| C191 | Number of pls/rev for encoder B | BASIC | 1191 | 1024 |
| C192 | Speed searching error timeout | ENGINEERING | 1192 | 5.00 sec |
| C193 | Error between reference and speed | ENGINEERING | 1193 | 300 rpm |
| C194 | Tracking error alarm enabling | ENGINEERING | 1194 | 1: Active |
| C195 | Filter time constant over value of feedback from encoder | ENGINEERING | 1195 | 5.0 ms |
| C196 | Filter time constant over value of reference from encoder | ENGINEERING | 1196 | 5.0 ms |
| C197 | Number of channels of Encoder A | ENGINEERING | 1197 | 0:2 Squaring channels |
| C198 | Number of channels of Encoder B | ENGINEERING | 1198 | 0:2 Squaring channels |
| C199 | Encoder sign reversal | ENGINEERING | 1199 | 0[Fdbk.NO; Ref.NO] |

C189 Encoder/Frequency Input Operating Mode

| C189 | | | |
|---|---|---|---|
| | Range | 0 ÷ 14 | See Table 70 |
| | Default | 0 | 0 [Not used; Not used] |
| | Level | BASIC | |
| | Address | 1189 | |
| | Function | This parameter determines the operating mode of quick acquisition digital inputs. If MDI8 is used as a frequency input, the optional board for encoder B is not required. Digital input MDI6 may be used as a frequency input; if used along with MDI7, it can be used for encoder A reading.<br>Reading of both encoders A and B can be programmed; parameter **C189** defines the encoder to be used as a reference source (if set as a speed/torque reference source in the Control Method Menu or as a PID reference source in the PID Configuration Menu) and the encoder to be used as a speed feedback.<br>Configuration allowed for quick acquisition digital inputs is shown in Table 70.<br>**If the encoder is used as a reference source, the detected speed value will be saturated and scaled based on values in P073 and P074 respectively (minimum and maximum value for the encoder).**<br>*Example*:<br>**C189** [A Reference; B Unused], **P073** [–1500rpm], **P074** [1500rpm] if the encoder is used as a PID reference, the reference measure is expressed as a percentage of the max. value [\|**P073**\|; \|**P074**\|].<br><br>If a frequency input is selected, its reading is saturated and scaled based on parameters P071 and P072 respectively (minimum and maximum value for the frequency input). | |

Table 70: Codification of C189

| Value | Using Encoder A/FINA | Using Encoder B/FINB |
|---|---|---|
| 0 | *Not used* | *Not used* |
| 1 | **EncA Feedback** | *Not used* |
| 2 | **EncA Reference** | *Not used* |
| 3 | *Not used* | **EncB Feedback** |
| 4 | *Not used* | **EncB Reference** |
| 5 | **EncA Feedback** | **EncB Reference** |
| 6 | **EncA Reference** | **EncB Feedback** |
| 7 | **EncA Reference and Feedback** | *Not used* |
| 8 | *Not used* | **EncB Reference and Feedback** |
| 9 | **MDI6 Frequency Input** | *Not used* |
| 10 | *Not used* | **MDI8 Frequency Input** |
| 11 | **MDI6 Frequency Input** | **EncB Reference** |
| 12 | **EncA Reference** | **MDI8 Frequency Input** |
| 13 | **MDI6 Frequency Input** | EncB Feedback |
| 14 | **EncA Feedback** | **MDI8 Frequency Input** |

Values 7-8: the same encoder can be used both as a reference source and as a reference feedback. Value 7: encoder A can be used both as a speed feedback for the motor control and as a PID regulator reference.

## C190 Number of Pls/Rev for Encoder A

| C190 | | | |
|---|---|---|---|
| | Range | 256 ÷ 10000 | 256 ÷ 10000 pls/rev |
| | Default | 1024 | 1024 |
| | Level | BASIC | |
| | Address | 1190 | |
| | Function | Defines the number of pls/rev for encoder A (encoder in the terminal board). | |

## C191 Number of Pls/Rev for Encoder B

| C191 | | | |
|---|---|---|---|
| | Range | 256 ÷ 10000 | 256 ÷ 10000 pls/rev |
| | Default | 1024 | 1024 |
| | Level | BASIC | |
| | Address | 1191 | |
| | Function | Defines the number of pls/rev for encoder B (encoder that can be connected to the ES836 optional board). | |

## C192 Timeout for Speed Alarm

| C192 | | | |
|---|---|---|---|
| | Range | 0 ÷ 65000 | 0.00 ÷ 650.00 sec |
| | Default | 500 | 5.00 sec |
| | Level | ENGINEERING | |
| | Address | 1192 | |
| | Function | If the speed alarm (**C194**) is enabled and the speed error exceeds the speed threshold (**C193**), this parameter determines the speed error timeout. Even if the alarm speed is disabled, time set in **C192** and error threshold set in **C193** are used for a speed searching error to digital outputs set with BRAKE or LIFT mode. Digital outputs are then disabled. | |

### C193 Speed Error Threshold

| C193 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32000 | 0 ÷ 32000 rpm |
| | Default | 300 | 300 rpm |
| | Level | ENGINEERING | |
| | Address | 1193 | |
| | Function | If the speed alarm (**C194**) is enabled and the speed error exceeds the speed threshold (**C193**), this parameter determines the error threshold for the speed error timeout. Even if the alarm speed is disabled, time set in **C192** and error threshold set in **C193** are used for a speed searching error to digital outputs set with BRAKE or LIFT mode. Digital outputs are then disabled. | |

### C194 Speed Error Enabling

| C194 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: Disabled<br>1: Enabled |
| | Default | 1 | 1: Enabled |
| | Level | ENGINEERING | |
| | Address | 1194 | |
| | Function | This parameter enables the speed error alarm. | |

### C195 Filter Time Constant over Value of Feedback from Encoder

| C195 | | | |
|---|---|---|---|
| | Range | 0 ÷ 30000 | 5 ÷ 3000.0 ms |
| | Default | 50 | 5.0 ms |
| | Level | ENGINEERING | |
| | Address | 1195 | |
| | Function | This parameter defines the time constant used for filtering the reading of the encoder used as a speed feedback. | |

### C196 Filter Time Constant over Value of Reference from Encoder

| C196 | | | |
|---|---|---|---|
| | Range | 0 ÷ 30000 | 5 ÷ 3000.0 ms |
| | Default | 50 | 5.0 ms |
| | Level | ENGINEERING | |
| | Address | 1196 | |
| | Function | This parameter defines the time constant used for filtering the reading of the encoder used as a reference. | |

### C197 Number of Channels of Encoder A

| C197 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: 2 Squaring Channels<br>1: Channel only |
| | Default | 0 | 0: 2 Squaring Channels |
| | Level | ENGINEERING | |
| | Address | 1197 | |
| | Function | This parameter defines the number of channels used for encoder A reading. Factory-setting is 2 Squaring channels. Speed can be read through one channel only (as for phonic wheel); channel 2 can define the direction of rotation (low level → negative rotation; high level → positive rotation). | |

C198 Number of Channels of Encoder B

| C198 | Range | 0 ÷ 1 | 0: 2 Squaring channels<br>1: Channel only |
|---|---|---|---|
| | Default | 0 | 0: 2 Squaring channels |
| | Level | ENGINEERING | |
| | Address | 1198 | |
| | Function | This parameter defines the number of channels used for encoder B reading (see parameter C197). | |

C199 Encoder Sign Reversal

| C198 | Range | 0 ÷ 3 | See Table 71 |
|---|---|---|---|
| | Default | 0 | 0 [Fdbk. NO ; Ref. NO] |
| | Level | ENGINEERING | |
| | Address | 1199 | |
| | Function | This parameter permits to reverse the speed sign measured by encoder inputs. | |

NOTE

By tuning the encoder, the encoder sign used as feedback is automatically adapted to the direction of rotation of the motor.

Table 71: Codification of C199

| Value | Feedback Encoder Sign Reversal | Reference Encoder Sign Reversal |
|---|---|---|
| 0 | Fdbk. NO | Ref. NO |
| 1 | Fdbk. YES | Ref. NO |
| 2 | Fdbk. NO | Ref. YES |
| 3 | Fdbk. YES | Ref. YES |

# 30. BRAKING RESISTANCE MENU

## 30.1. Overview

The Braking Resistance Menu enables the clamp transistor command and sets its max. duty cycle in the inverter braking resistance. If no braking resistance is installed, it is possible to adjust promptness of the DC bus voltage control in order to avoid OVERVOLTAGE alarm, causing abrupt deceleration.
When the clamp transistor command is enabled, braking resistance is obtained by setting **C210** [With Resistance] (where With Resistance = –0.01). In this operating mode, when DC bus voltage exceeds a preset threshold value depending on the inverter voltage class, the clamp transistor closes in the braking resistor, so energy in excess is dissipated over the resistor and DC bus voltage does not exceed voltage ratings.
The max. duty cycle of the braking resistor is parameterized with **C212** and **C211**, respectively: maximum duty cycle (100 * Ton / (Ton+Toff) [%] ) and maximum time of continuous supply (Ton). If the braking resistor activation is Ton = **C212** , when this interval is over, the relevant command will be disabled for a time equal to Toff = (100 – **C212**) * **C211** / **C212** [sec].
Factory-setting assumes that no braking resistor is provided. In this case, **C210** sets the promptness, with respect to variations of DC bus, for the deceleration ramp slowing-down, in order not to overload the bus capacitor bank.
If **C210** is set to zero in FOC control, deceleration slows down when given values of the voltage bar are reached (depending on the inverter voltage class).
If **C210** is > 0, DC bus voltage is controlled by considering the derivative of the bus voltage. The higher the value in **C210**, the lower the values for voltage variation affecting the deceleration ramp time.

NOTE

The clamp transistor is not commanded if the inverter is supplied from a Regenerative source (see **C008** = xT Regen, where x can be 2, 4, 5, or 6 ).

## 30.2. List of Parameters from C210 to C212

Table 72: List of Parameters C210 ÷ C212

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C210 | Automatic extension down ramp | ENGINEERING | 1210 | 0.20% |
| C211 | Max. time of continuous supply | ENGINEERING | 1211 | 2.00sec |
| C212 | Duty Cycle Braking (Ton/(Toff+Ton)) | ENGINEERING | 1212 | 10% |

C210 Automatic extension down ramp

| C210 | | | |
|---|---|---|---|
| | Range | -1 ÷ 32000 | –0.01: (With Resistance); 320.00% |
| | Default | 20 | 0.20% |
| | Level | ENGINEERING | |
| | Address | 1210 | |
| | Function | If **C210** = [With Resistance], this parameter commands enabling resistor and DC bus relating to this operating condition, allowing to dissipate energy regenerated from the motor. If no braking resistor is used, energy regenerated from the motor cannot be dissipated. In this condition, the down ramp is extended if the variation in DC bus voltage is too rapid or if it exceeds certain threshold values. Set a higher value in parameter **C210** for a more sensitive ramp extension (a lower variation in DC bus voltage allows to obtain longer ramps). | |

C211 Max. time of continuous supply for braking resistance

| C211 | | | |
|---|---|---|---|
| | Range | 0 ÷ 32000 | 0 ; 320.00 sec |
| | Default | 200 | 2.00 sec |
| | Level | ENGINEERING | |
| | Address | 1211 | |
| | Function | This parameter determines the max. continuous operating time required for the braking resistance. If the braking resistance is used for a time **C211** without being activated, the braking resistance command is automatically disabled for a time of inactivity set in **C212**. | |

C212 Maximum Time of Continuous Supply

| C212 | | | |
|---|---|---|---|
| | Range | 0 ÷ 100 | 0 ÷ 100% |
| | Default | 10 | 10% |
| | Level | ENGINEERING | |
| | Address | 1212 | |
| | Function | **C212** = (Ton/(Ton+Toff))*100<br>This parameter determines the operating duty cycle allowed for the braking resistance. It is expressed as a percentage and defines the time of inactivity of the braking resistance when it continuously operates for the max. time set in **C211**. | |

# 31. DC BRAKING MENU

## 31.1. Overview

Using the IFD or VTC control algorithm, DC current is injected to the motor to stop it. DC current may be automatically injected at stop and/or at start; DC current injection may also be controlled by the terminal board. All relevant parameters are included in the DC BRAKING MENU. The intensity of the DC current injected is expressed as a percentage of the rated current of the active motor.

### 31.1.1. DC BRAKING AT START AND NON-CONDENSING FUNCTION

To activate DC braking at start, set **C216** to [YES]. Braking occurs after sending a **START** command, with a speed reference other than zero, before the acceleration ramp. A **START** command may be one of the following: **RUN** command or **REV** command sent via terminal board; **START** command from keypad, etc., depending on the preset control mode. DC braking level and duration are set in parameters:

**C220** Expressed as a percentage of the rated current of the controlled motor.
**C218** Expressed in seconds.

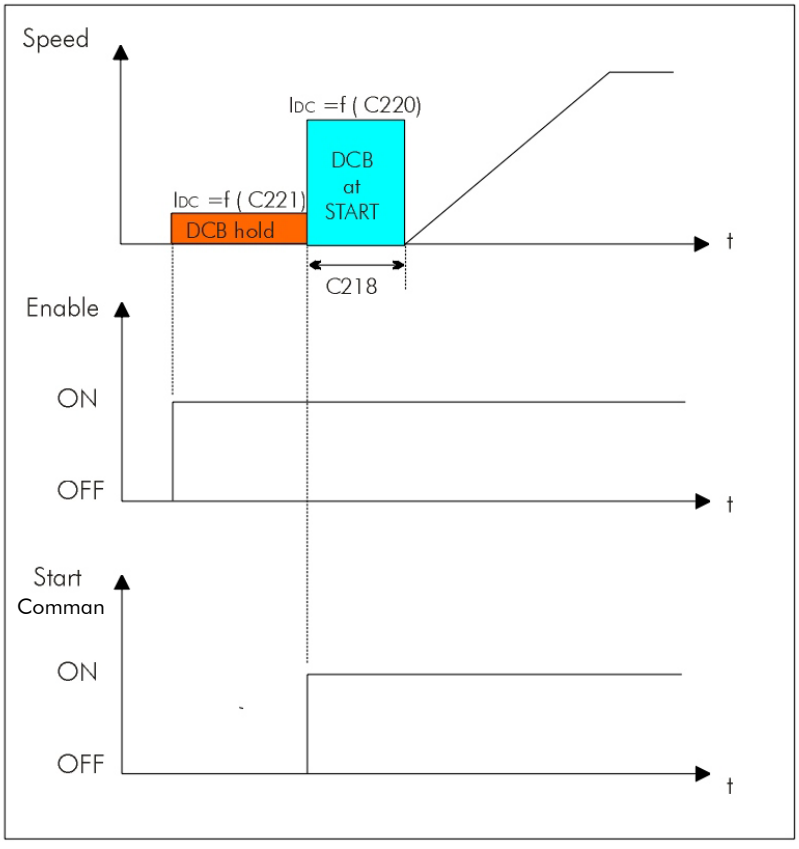



Figure 39: DCB Hold and DCB at Start

Output speed, holding and DC braking current when the DCB Hold and DCB at Start functions are active.

The non-condensing function consists in injecting DC to the motor. DC current brakes the motor and heats the motor windings, thus avoiding condensation. This function is active only for the IFD control if **C221** is other than zero and **ENABLE** = ON. For the other control algorithms, the non-condensing function is performed by injecting current during motor fluxing. Parameter **C221**, expressed as a percentage of the rated current of the controlled motor, determines the level of direct current injected to the braking resistance.

Parameters used to program this function are the following:

**C216** enabling DCB at Start;
**C218** setting the duration of DCB at Start;
**C220** the intensity of the DC braking;
**C221** the intensity of the holding current (this function is active for the IFD control only).

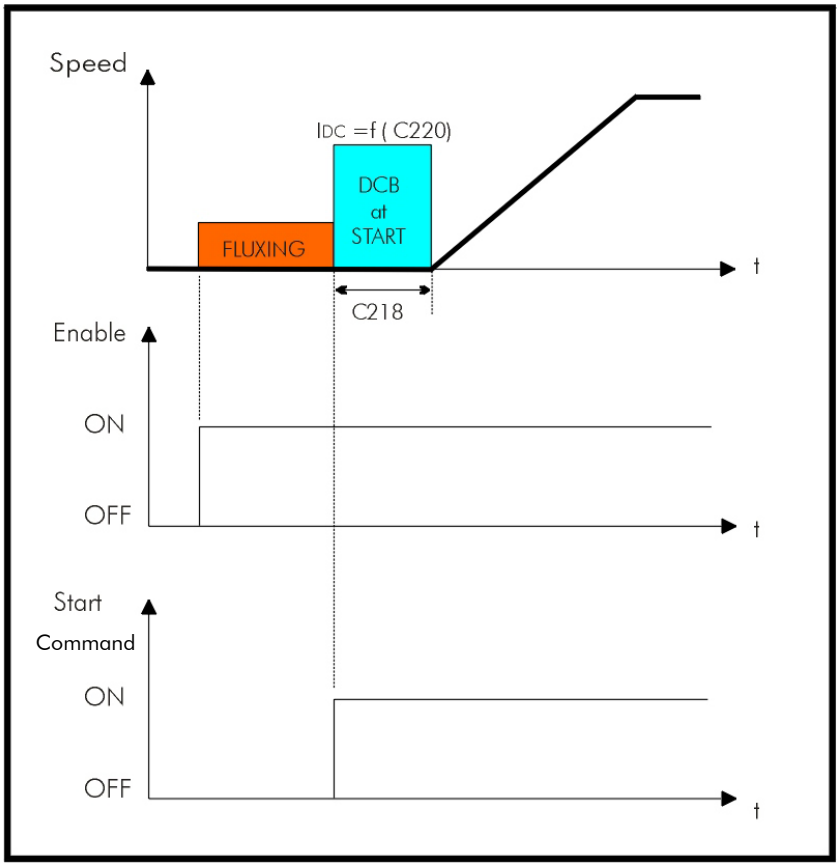



**Figure 40: DCB at Start with VTC Control**

Output Speed and DC Braking when the DCB At Start Function is active for the Vector Torque control.

## 31.1.2. DC BRAKING AT STOP

To activate this function, set **C215** to [YES] or, in Power Down mode, set **C234** (Power Down Stop Mode) as DCB. DC Braking occurs after sending a "stop with ramp" command. The speed level for DC Braking is set in **C219**. If the inverter is in Power Down mode and **C234** is set as DCB, the speed level is set in **C235** (Power Down Stop Level).
The figure below illustrates the output speed and DC Braking trends when the DC Braking at Stop function is active.

Parameters used to program this function are the following:

**C215** function enabling;
**C217** braking duration;
**C219** motor speed at the beginning of DC Braking;
**C220** intensity of DC braking.
In Power Down mode, if **C234** (Power Down Stop Mode) is set as DCB:
**C235** motor speed at the beginning of DC Braking.

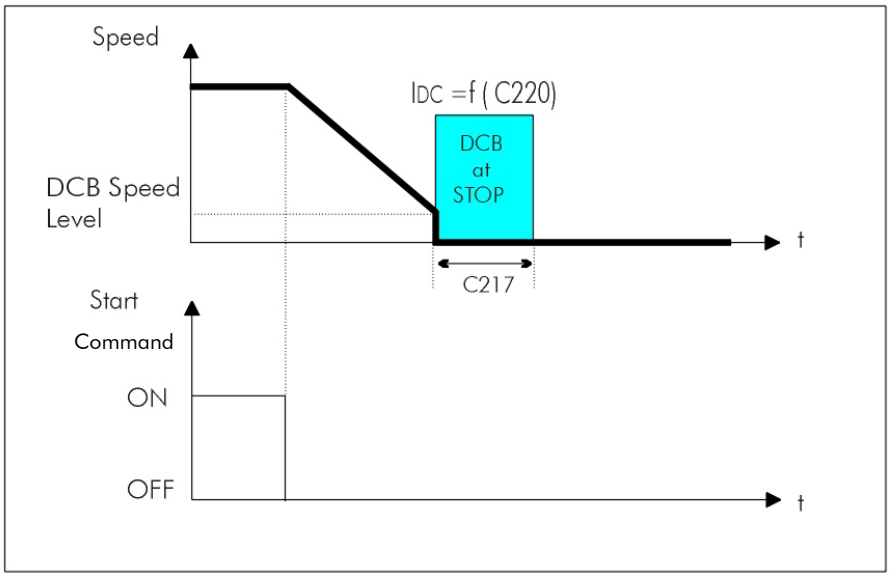



Figure 41: DCB at Stop

Motor speed and DC Braking trends when the DC BRAKING AT STOP function is active.

## 31.1.3. DC BRAKING COMMAND SENT FROM TERMINAL BOARD

Activate the digital input set as DCB (**C160**) to send a DC Braking command. DC Braking duration is determined by the following formula:

$t^* = C217 * ( n_{OUT} / C219 )$ with $n_{OUT} / C219$ equal to max. 10.

Possible cases:

a) **t1 > t*** time t1 for braking command is longer than t*.

To restart the motor following the preset acceleration ramp when DC Braking is over, simply disable the DCB command and disable and enable again the **START** command (see figure below).

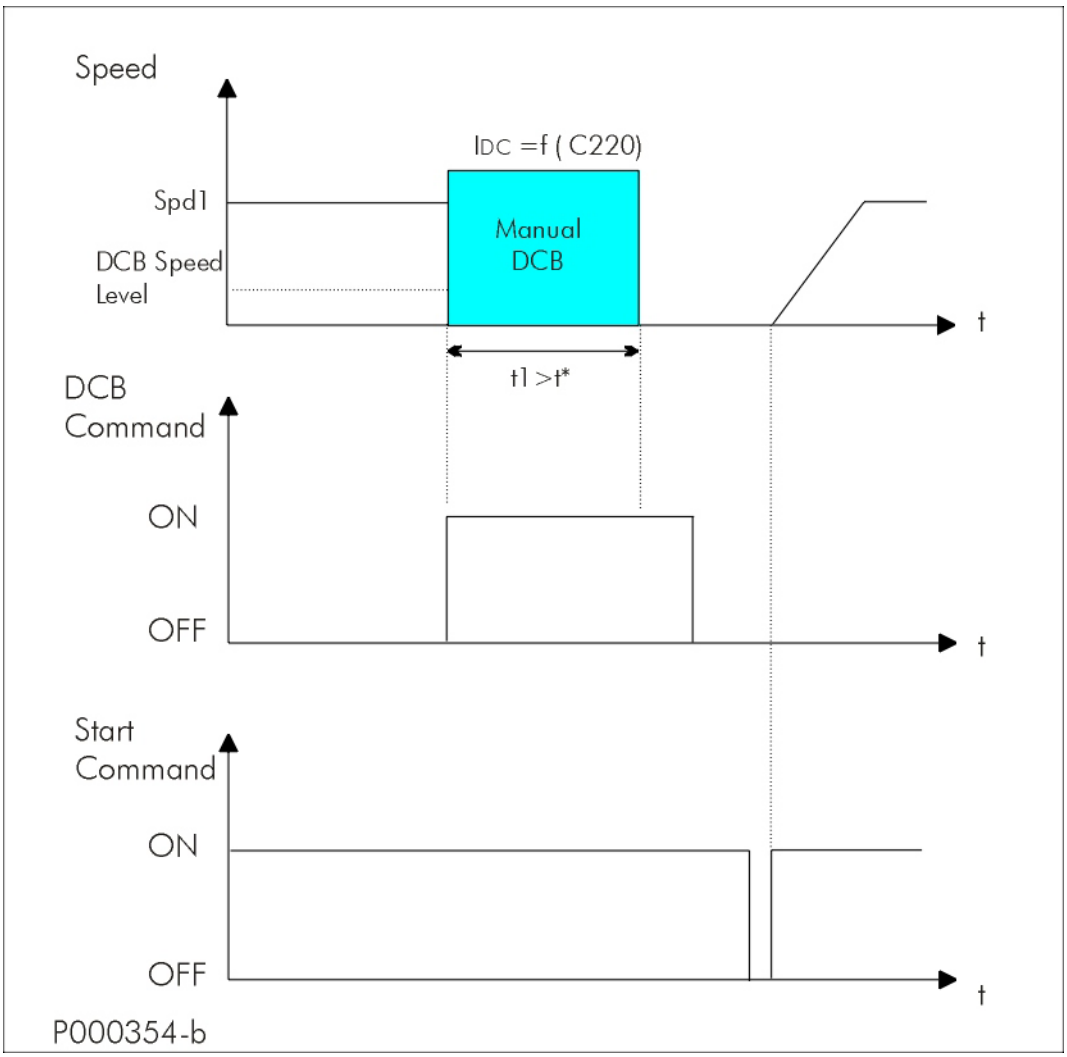



**Figure 42: Manual DCB (Example 1)**

Motor Speed, DC Braking, Manual DCB Command and **START** Command if t1 >t*

b) **t1 < t*** time t1 for braking command is shorter than t*.

Two different cases may occur, depending on the control algorithm and the setup of the motor speed searching function.

IFD or VTC Control when the Speed Searching function is disabled (C245 [NO]):
Prematurely disable the manual braking command to stop DC braking. If the motor is still rotating, it will start idling. To restart the motor following the preset acceleration ramp, simply disable and enable the START command (see Figure 42).

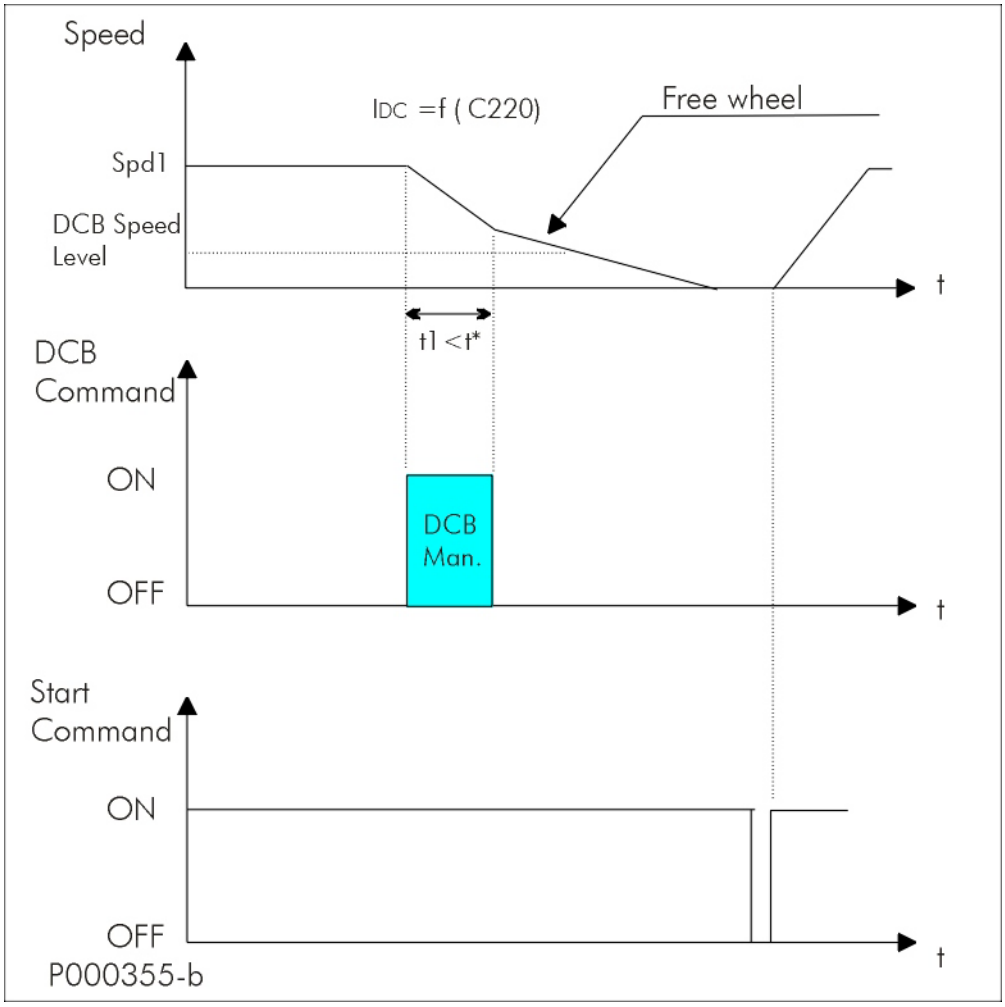



Figure 43: Manual DCB (Example 2)

Motor Speed, DC Braking, Manual DCB Command and START Command if t1<t* and the control algorithm is either IFD Voltage/Frequency or VTC VectorTorque when the Speed Searching Function is disabled.

IFD Control when the Speed Searching function is enabled (C245 [YES]):

Prematurely disable the manual braking command to activate the Speed Searching function. When the motor speed searching occurs, the motor speed is increased depending on the preset acceleration ramp (see Figure 43).

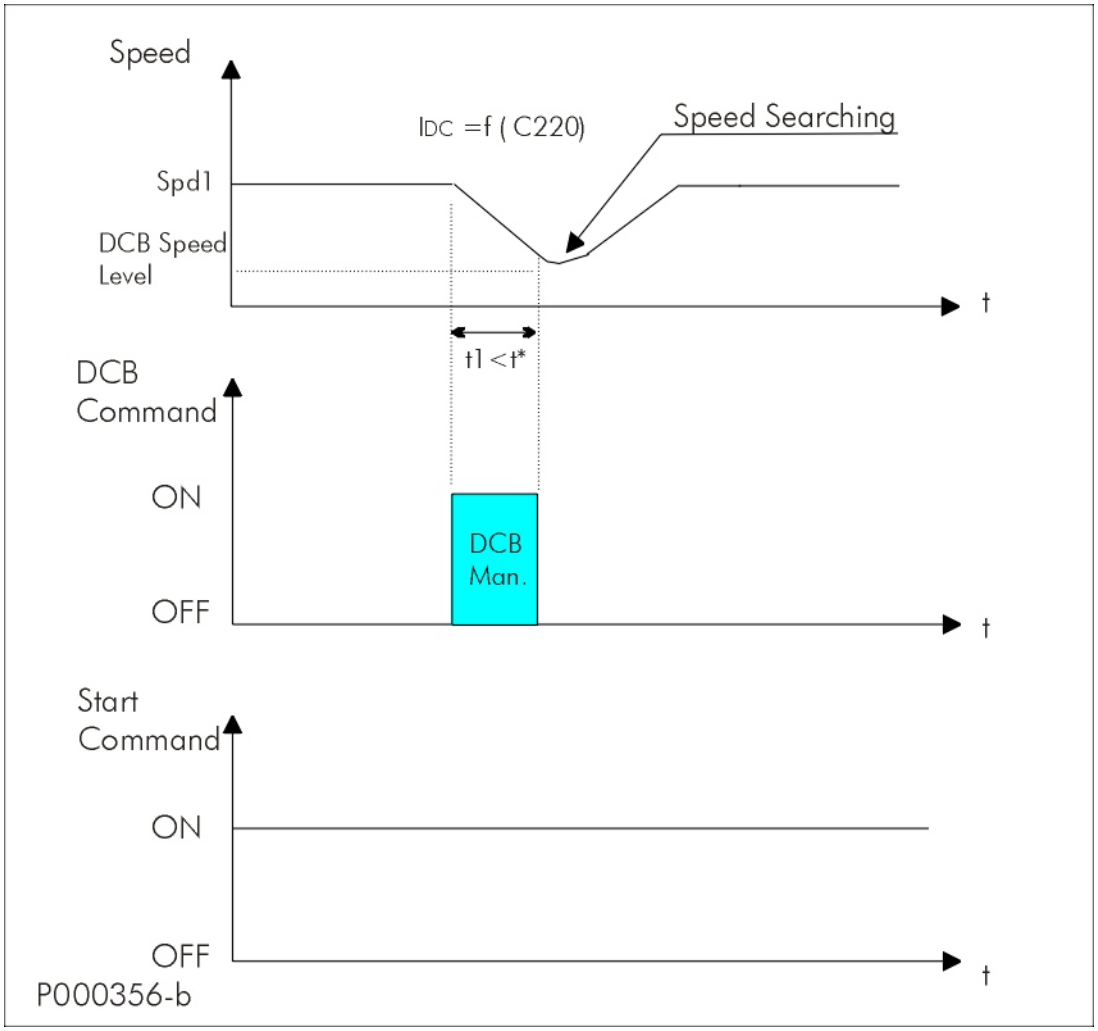



Figure 44: Manual DCB (Example 3)

Motor Speed, DC Braking and Manual DCB Command and **START** Command if t1<t*, the control algorithm is IFD and the Speed Searching Function is enabled.

## 31.2. List of Parameters from C215 to C224

List of Parameters C215 ÷ C221

**Table 73: List of Parameters C215 ÷ C221**

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| C215 | Enabling DCB at Stop function | ADVANCED | 1215 | 0:NO |
| C216 | Enabling DCB at Start function | ADVANCED | 1216 | 0:NO |
| C217 | DCB at Stop duration | ADVANCED | 1217 | 0.5 |
| C218 | DCB at Start duration | ADVANCED | 1218 | 0.5 |
| C219 | Speed at the beginning of DCB at Stop | ADVANCED | 1219 | 50rpm |
| C220 | DCB current level | ADVANCED | 1220 | 100% |
| C221 | DC current in holding | ADVANCED | 1221 | 0% |
| C222 | Ramp braking time for Motor 1 DCB | ENGINEERING | 1222 | See Table 52 |
| C223 | Ramp braking time for Motor 2 DCB | ENGINEERING | 1223 | See Table 52 |
| C224 | Ramp braking time for Motor 3 DCB | ENGINEERING | 1224 | See Table 52 |

C215 Enabling DCB at Stop Function

| C215 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: No; 1: Yes |
| | Default | 0 | 0: No |
| | Level | ADVANCED | |
| | Address | 1215 | |
| | Control | IFD and VTC | |
| | Function | Enables the DC Braking during deceleration when the speed set in **C219** is reached (or the speed set in **C235** if in Power Down mode and **C234** [DCB]). | |

C216 Enabling DCB at Start Function

| C216 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: No; : Yes |
| | Default | 0 | 0: No |
| | Level | ADVANCED | |
| | Address | 1216 | |
| | Control | IFD and VTC | |
| | Function | Enables the DC Braking at Start function. | |

C217 DCB at Stop Duration

| C217 | | | |
|---|---|---|---|
| | Range | 1 ÷ 600 | 0.1; 60.0 sec. |
| | Default | 5 | 0.5 |
| | Level | ADVANCED | |
| | Address | 1217 | |
| | Control | IFD and VTC | |
| | Function | Determines the duration of the DCB at Stop function. | |

### C218 DCB at Start Duration

| C218 | Range | 1 ÷ 600 | 0.1; 60.0 sec. |
|---|---|---|---|
| | Default | 5 | 0.5 |
| | Level | ADVANCED | |
| | Address | 1218 | |
| | Control | IFD and VTC | |
| | Function | Determines the duration of the DCB at Start function. | |

### C219 Speed at the Beginning of DCB at Stop

| C219 | Range | 0; 1000 | 0; 1000 rpm |
|---|---|---|---|
| | Default | 50 | 50rpm |
| | Level | ADVANCED | |
| | Address | 1219 | |
| | Control | IFD and VTC | |
| | Function | Determines the speed at the beginning of DCB at stop while decelerating. | |

### C220 DCB Current Level

| C220 | Range | 0; MIN [ 120%; (inverter Imax /motor Inom)*100)% ] | |
|---|---|---|---|
| | Default | 100 | 100% |
| | Level | ADVANCED | |
| | Address | 1220 | |
| | Control | IFD and VTC | |
| | Function | Determines the level of direct current injected to brake the motor.<br>It is expressed as a percentage of the rated current of the controlled motor. | |

### C221 DC current in holding

| C221 | Range | 0 ÷ 100 | 0; 100% |
|---|---|---|---|
| | Default | 0 | 0% |
| | Level | ADVANCED | |
| | Address | 1221 | |
| | Control | IFD | |
| | Function | Determines the level of direct current injected during the holding function.<br>To activate this function, set a value other than zero in parameter **C221**.<br>DC level is expressed as a percentage of the rated current of the controlled motor. | |

### C222 (C223, C224) Ramp braking time for DCB

| C222 (motor 1)<br>C223 (motor 2)<br>C224 (motor 3) | Range | 2 ÷ 32000 | 2 ÷ 32000 msec |
|---|---|---|---|
| | Default | See Table 52 | |
| | Level | ENGINEERING | |
| | Address | 1222<br>1223<br>1224 | |
| | Control | IFD and VTC | |
| | Function | This parameter represents the time required for flux weakening before DCB. | |

# 32. POWER DOWN MENU

## 32.1. Overview

In the case of power failure, the inverter can be kept powered on by exploiting the kinetic energy of the motor and the load: energy recovered due to motor slowing down is used to power the inverter, thus avoiding loosing the inverter control when a black–out occurs.
All parameters relating to the Power Down function are included in the Power Down submenu in the Configuration menu.
The following options are available (parameter **C225**):
– [**NO**]: the Power Down function is inhibited (factory setting). In this case only, it is possible to enable alarm **A064** (mains loss) by setting **C233** to [Yes].
– [**YES**]: after the time set in **C226** (Power Down start delay), starting from the instant when power down occurs, a deceleration ramp takes place (deceleration ramp in Power Down **C227**). The time period of the deceleration ramp can be user-defined.
– [**YES V**]: in case of power down for a time longer than **C226**, the motor coasts to stop, so that DC bus voltage value is kept constant at **C230**. To do so, a PI (proportional–integral regulator) is used, which is adjusted through parameter **C231** (proportional term) and **C232** (integral term).

NOTE

If the mains loss deactivates the **ENABLE** command, the motor cannot coast to stop, because the **ENABLE** command is required for the hardware enabling of IGBTs.

NOTE

If an inverter is DC-powered by a Regenerative Penta (or an equivalent drive stabilizing DC bus voltage), Power Down cannot occur (**C008** = xT Regen, where x can be 2, 4, 5, or 6 ).

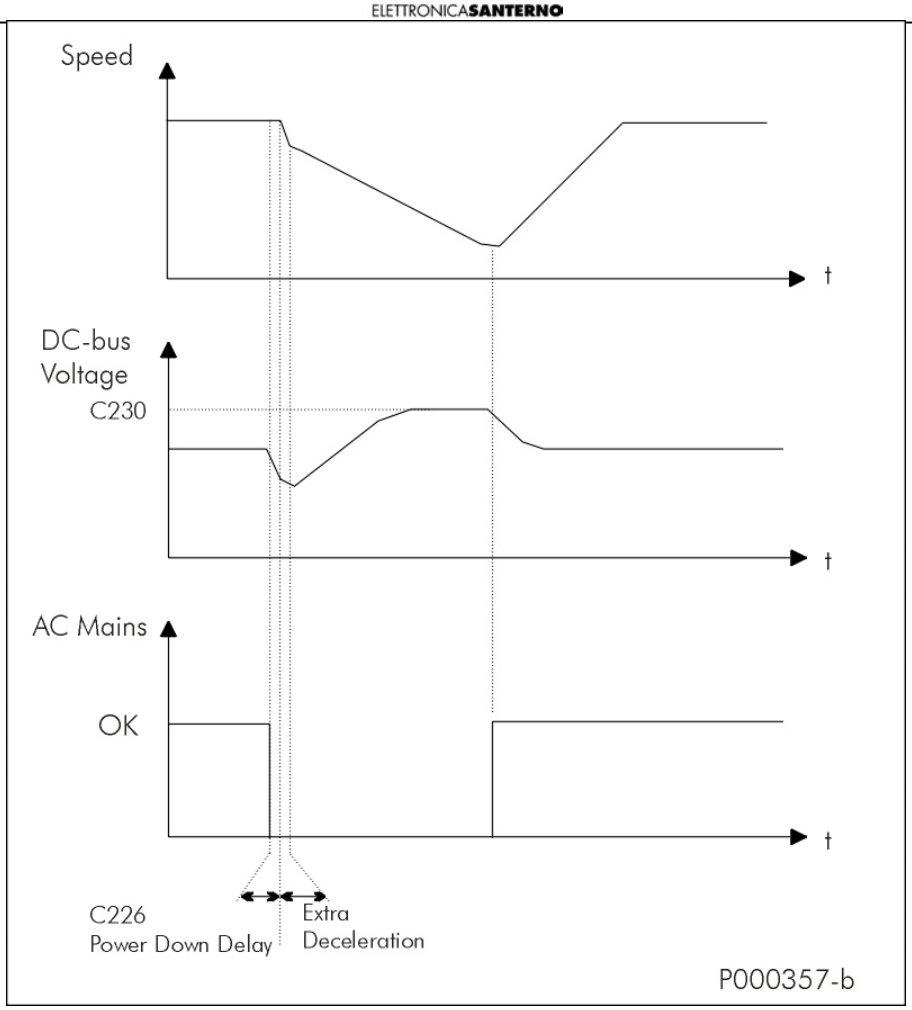



**Figure 45: Power Down (Example)**

The figure above illustrates the trends of the motor speed and the DC bus voltage in case of mains loss. In this case, power supply is restored before the inverter turns off and before the deceleration ramp is over, so the motor accelerates with the preset acceleration ramp.

If power supply is restored during the deceleration ramp in Power Down, the connected motor accelerates following the selected acceleration ramp. A speed value for the end of Power Down can be set in **C235**; the desired operating mode at stop can be set in **C234**.
When the motor speed a DC Bus Voltage end level of Power Down, the following functions can be selected in parameter **C234**:
– [**Stop**]: Regardless of t set in **C235**, the inverter will control the motor until it stops down; when the motor stops and power supply is restored, the RUN command must be disabled and enabled again to accelerate the motor.
– [**DCB**]: When the speed of the Power Down end set in **C235** is attained, DC braking occurs. If power supply is restored during DC braking, the RUN command must be disabled and enabled again to accelerate the motor.
– [**Stand–By**] : When the speed of the Power Down end set in **C235** is attained, the inverter is placed on stand–by; if power supply is restored when the inverter is on stand-by, the RUN command must be disabled and enabled again to accelerate the motor.

Mains
Detection

Extradeceleration

## 32.2. List of Parameters from C225 to C235

Table 74: List of Parameters C225 ÷ C235

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C225 | Procedure in case of Power Down | ENGINEERING | 1225 | 0:Disabled |
| C226 | Power Down enabling delay | ENGINEERING | 1226 | 10 ms |
| C227 | Stop ramp time in Power Down | ENGINEERING | 1227 | 20 sec |
| C228 | Start increment of ramp gradient in P.D. | ENGINEERING | 1228 | 0.10% |
| C229 | Increase sensibility of DC bus control | ENGINEERING | 1229 | 1 |
| C230 | Voltage level of DC bus in Power Down | ENGINEERING | 1230 | 339V for class 2T<br>679V for class 4T(380;480V)<br>707V for class 4T(481;500V)<br>813V for class 5T<br>976V for class 6T |
| C231 | Proportional constant PI of automatic deceleration | ENGINEERING | 1231 | 0.050 |
| C232 | Integral time PI of automatic deceleration | ENGINEERING | 1232 | 0.5 sec |
| C234 | Ramp action at the end of Power Down | ENGINEERING | 1234 | 0: Stop |
| C235 | Motor speed at the end of Power Down | ENGINEERING | 1235 | 0 rpm |

C225 Procedure in case of Power Down

| C225 | Range | 0 ÷ 3 | 0: Disabled<br>1: Yes<br>2: YesV<br>3: Alarm |
|---|---|---|---|
| | Default | 0 | 0: Disabled |
| | Level | ENGINEERING | |
| | Address | 1225 | |
| | Function | Type of power down:<br>0: **Disabled** The Power Down function is disabled.<br>1: **Yes** In case of mains loss after a time longer than the time set in **C226** starting from the mains loss detection, the deceleration ramp set in **C227** is performed.<br>2: **YesV** In case of mains loss, deceleration is automatically regulated by a PI regulator (see **C231** and **C232**), so that voltage level in DC link is kept constant at the reference value set in **C230**.<br>IFD control: because no torque demand regulation is available, the deceleration ramp gradient is adjusted depending on the gradient value set in **C227**.<br>3: **Alarm** In case of power failure, the **A064 Mains Loss** alarm is trips. | |

NOTE

If an inverter is DC-powered by a Regenerative Penta (or an equivalent drive stabilizing DC bus voltage), Power Down cannot occur (**C008** = xT Regen, where x can be 2, 4, 5, or 6 ).

## C226 Power Down Enabling Delay

| C226 | | | |
|---|---|---|---|
| | Range | 1 ÷ 250 | 1 ÷ 250 ms |
| | Default | 10 | 10 ms |
| | Level | ENGINEERING | |
| | Address | 1226 | |
| | Function | This parameter determines the Power Down delay after a mains loss is detected by the inverter. When Power Down is disabled (**C225** =Disable) and the mains loss alarm is enabled (**C233**=Yes), the Power Down enabling delay is applied to the alarm trip. | |

**NOTE** To delay excessively the power down during a mains loss, can use the inverter switch off

## C227 Stop Ramp Time in Power Down

| C227 | | | |
|---|---|---|---|
| | Range | 1 ÷ 32000 | 1 ÷ 32000 sec |
| | Default | 20 | 20 sec |
| | Level | ENGINEERING | |
| | Address | 1227 | |
| | Function | Determines the gradient of the deceleration ramp occurring at Power Down (after the first extra deceleration stage) if **C225** = Yes.<br>Control algorithm IFD: **C227** is the basic gradient for deceleration adjustment when **C225**= Yes V. | |

## C228 Start Increment of Ramp Gradient in Power Down

| C228 | | | |
|---|---|---|---|
| | Range | -100 ÷ 10000 | -1.00 ÷ + 100.00 % |
| | Default | 10 | 0.10% |
| | Level | ENGINEERING | |
| | Address | 1228 | |
| | Function | Determines an increase in deceleration ramp gradient at the beginning of the Power Down function. This is required to increase DC bus voltage.<br>**C228 = 0%** start deceleration is due to C227 (C228 has no effect)<br>**C228 = 100%** start deceleration is 100 times faster than deceleration set in C227 (start ramp = C227/100 sec)<br>**C228 = -1.00%** start deceleration is zero (deceleration ramp of infinite time) | |

## C229 Increase sensibility of DC bus control

| C229 | | | |
|---|---|---|---|
| | Range | 1 ÷ 250 | 1 ÷ 250 |
| | Default | 1 | 1 |
| | Level | ENGINEERING | |
| | Address | 1229 | |
| | Function | Based on voltage trend on the DC bus, this function allows to detect mains loss in advance.<br>If the value for this coefficient is too high, erroneous mains loss conditions can be detected, due to a sudden drop in DC bus voltage. | |

C230 Voltage Level of DC Bus in Power Down

| | | | |
|---|---|---|---|
| C230 | Range | 250 ÷ 450 for Class 2T<br>400 ÷ 800 for Class 4T<br>500 ÷ 960 for Class 5T<br>600 ÷ 1150 for Class 6T | 250 ÷ 450 V for Class 2T<br>400 ÷ 800 V for Class 4T<br>500 ÷ 960 V for Class 5T<br>600 ÷ 1150 V for Class 6T |
| | Default | 339 for Class 2T<br>679 for Class 4T (380÷ 480V)<br>707 for Class 4T (481÷ 500V)<br>813 for Class 5T<br>976 for Class 6T | 339 V for Class 2T<br>679 V for Class 4T (380÷ 480V)<br>707 V for Class 4T (481÷ 500V)<br>813 V for Class 5T<br>976 V for Class 6T |
| | Level | ENGINEERING | |
| | Address | 1230 | |
| | Function | Determines the reference value for DC bus voltage in case of automatic deceleration in Power Down; **C225** = Yes V. | |

C231 Proportional constant PI of automatic deceleration

| | | | |
|---|---|---|---|
| C231 | Range | 0 ÷ 32000 | 0.000 ÷ 32.000 |
| | Default | 50 | 0.050 |
| | Level | ENGINEERING | |
| | Address | 1231 | |
| | Function | Proportional coefficient used in PI regulator controlling automatic deceleration in case of Power Down; **C225** =Yes V. | |

C232 Integral time PI of automatic deceleration

| | | | |
|---|---|---|---|
| C232 | Range | 1 ÷ 32000 | 0.001 ÷ 31.999 sec<br>32000 = Disabled |
| | Default | 500 | 0.5 sec |
| | Level | ENGINEERING | |
| | Address | 1232 | |
| | Function | Integral time used in PI regulator controlling automatic deceleration in case of Power Down; **C225** =Yes V. | |

C234 Ramp action at the end of Power Down

| C234 | Range | 0 ÷ 2 | 0: Stop<br>1: Stand–by<br>2: Dcb |
|---|---|---|---|
| Ramp action at the end of Power Down | Default | 0 | 0: Stop |
| | Level | ENGINEERING | |
| | Address | 1234 | |
| | Function | When the motor speed during Power Down attains the Power Down end value set in **C235,** three operating modes are possible depending on **C234** programming:<br><br>[**Stop**] regardless of the speed value set in C235, if the inverter is capable of bearing DC bus voltage, it will control the motor until it stops. If power supply is restored when the deceleration ramp is over, the RUN command must be disabled and enabled again to accelerate the motor. If power supply is restored when the motor is still decelerating, the speed of reference is imposed to the motor with the preset acceleration ramp.<br><br>[**Stand–by**] When decelerating, once the speed value set in **C235** is attained, the inverter is put in stand–by and the motor keeps decelerating (motor idling). If power supply is restored, the same conditions as described in the step above occur (see [Stop]); instead of stopping the motor, the inverter is put in stand–by.<br><br>[**DCB**] When decelerating, once the speed value set in **C235** is attained, DC braking occurs. Its duration depends on the speed value set in **C235** and on DC braking parameters (see DC BRAKING MENU):<br>t* = **C217** * ( **C235** /**C219** )<br>with **C235**/**C219** equal to max. 10. If power supply is restored, the same conditions as described in the step above occur (see [Stop]); instead of stopping the motor, the inverter performs DC braking. | |

C235 Motor speed at the end of Power Down

| C235 | Range | 0 ÷ 5000 | 0 ÷ 5000 rpm |
|---|---|---|---|
| Motor Speed at the End of Power Down | Default | 0 | 0 rpm |
| | Level | ENGINEERING | |
| | Address | 1235 | |
| | Function | Motor speed at the end of Power Down.<br>If **C234** is set as [Stand–by], the inverter is put on stand-by; if **C234** is set as [DCB], it determines DC braking. Both conditions occur during the deceleration ramp due to Power Down and when the speed value set in **C235** is attained. | |

# 33. SPEED SEARCHING MENU

## 33.1. Overview

When a command is sent to disable the inverter, the motor idles. When the inverter activates again, the Speed Searching function allows the inverter to reach the motor speed.
All parameters relating to this function are included in the Speed Searching submenu in the Configuration menu.
For FOC control, the motor speed of rotation is always known, so this function is always active and independent of the parameters of the relevant menu.

**NOTE** The Speed Searching parameters are used for IFD control only.

When **C245** is set to [YES], do the following to activate the Speed Searching function:
– open and close the **ENABLE** command before $t_{SSdis}$ is over (**C246**);
– disable the DC Braking command before the DC braking preset time is over (see DC BRAKING MENU);
– reset any alarm tripped (with reference other than 0) before $t_{SSdis}$ is over.
Speed searching does not take place when the inverter turns off due to mains loss.
If the inverter restarts after a time longer than $t_{SSdis}$ (**C246**), frequency output is generated following the acceleration ramp, and no speed searching takes place.
By setting **C246 0: (Always On),** speed searching (if enabled with **C245**) occurs when the inverter restarts (RUN), regardless of the time elapsed from disabling.
The figures below show output frequency and motor rpm during speed searching.
After time $t_0$ for rotor demagnetization, speed searching occurs as follows (3 steps):

The speed at the beginning of search depends on the settings programmed in C249.

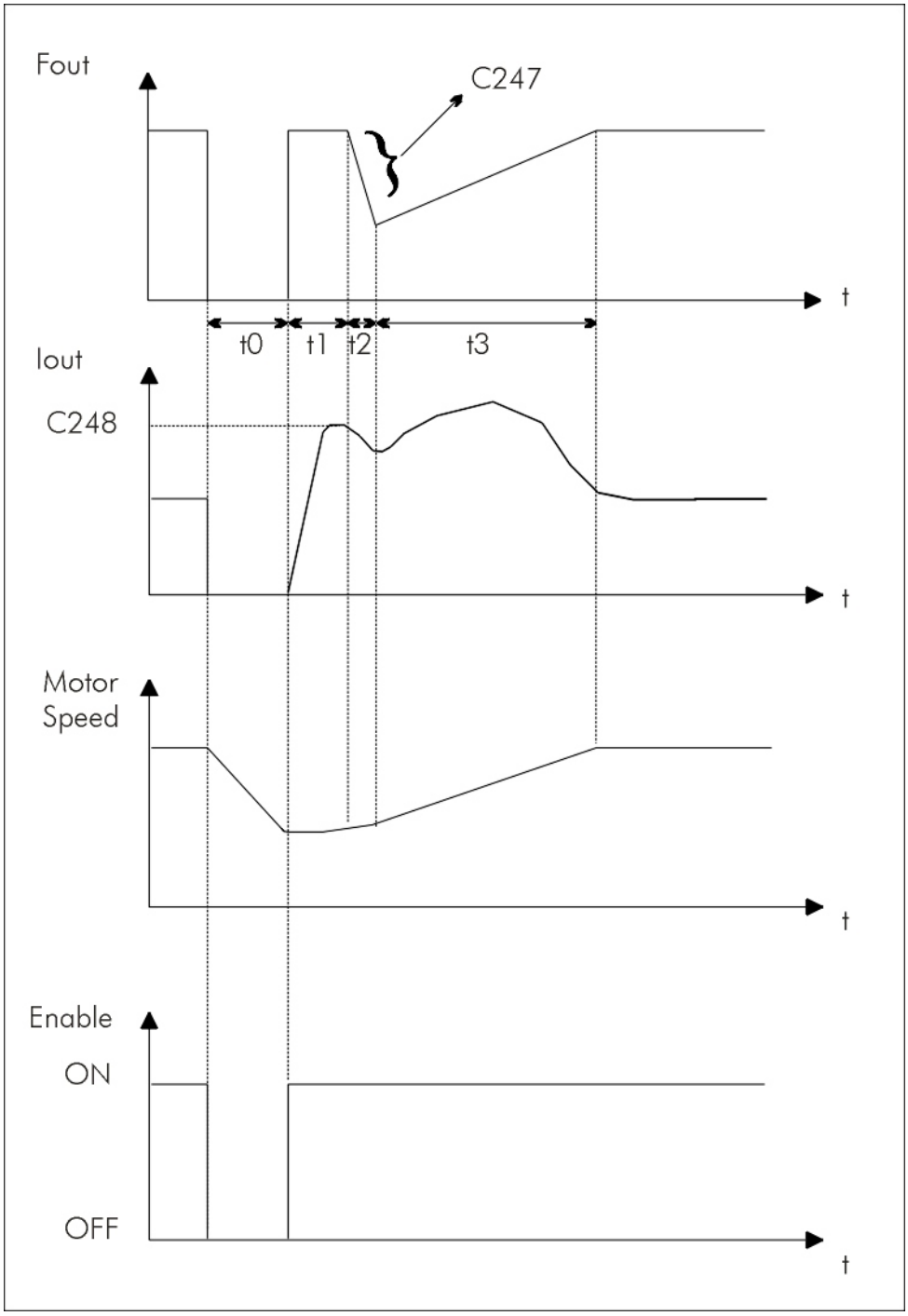



**Figure 46: Speed Searching (Example 1)**

– Output Frequency and motor RPM for the Speed Searching Function (**C245** = [YES]) activated by the **ENABLE** command. $t_O < t_{SSdis}$ (**C246**) or **C246** = 0.

Three stages:

**Time $t_1$** The inverter output frequency corresponds to the last value which was active before disabling the inverter; output current matches with the value set in **C248**;
**Time $t_2$** Output frequency is decremented following the ramp set in **C247** for rotation speed searching;
**Time $t_3$** The connected motor accelerates following the acceleration ramp.

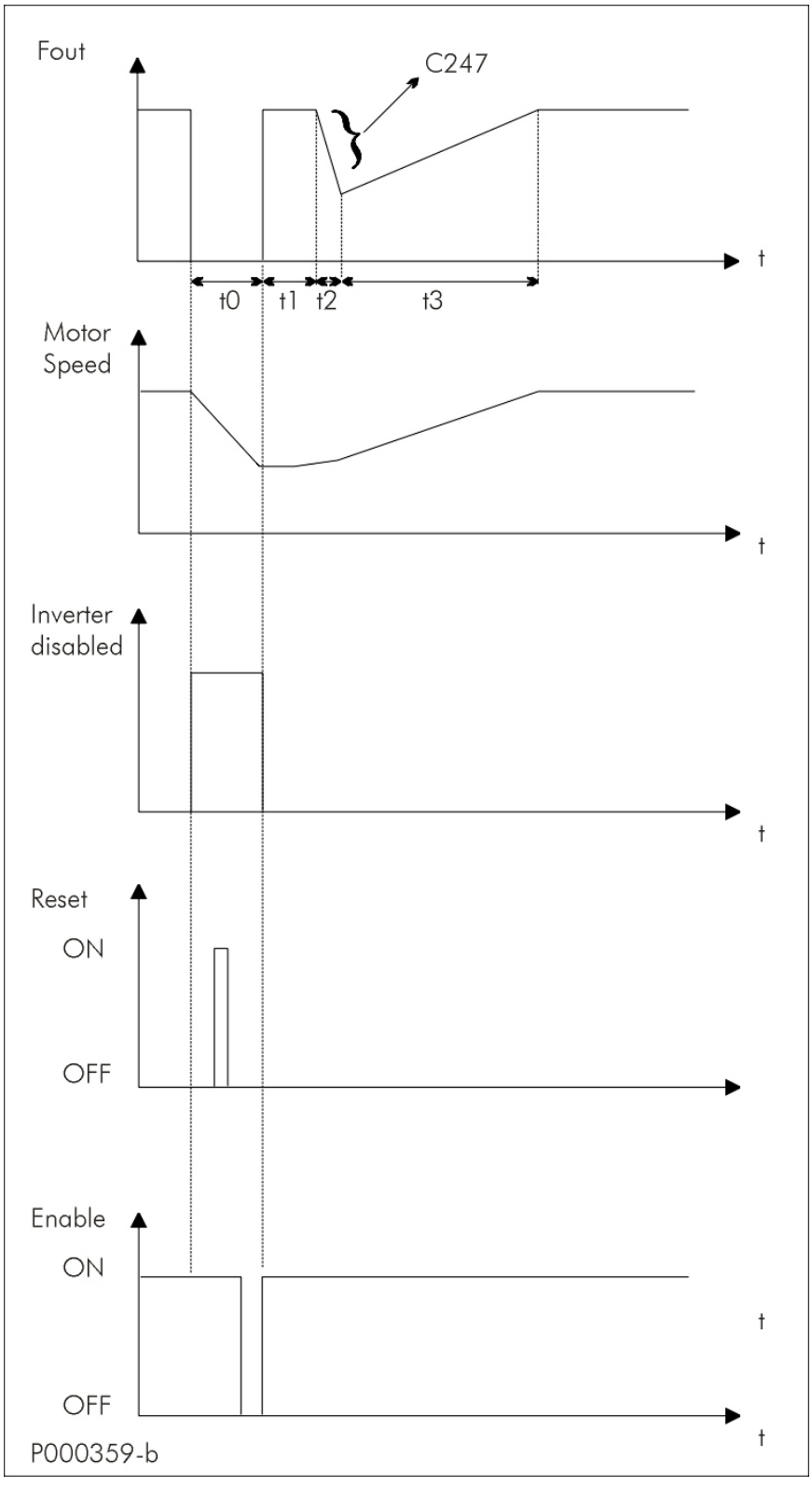



**Figure 47: Speed Searching (Example 2)**

Frequency, Motor Rpm, Inverter Lock, **RESET** and **ENABLE** during Speed Searching (**C245** =[YES]) due to an Alarm Trip $t_{OFF} < t_{SSdis}$ (**C246**) or **C246** = 0.

**NOTE**

If the Safety at Start function is disabled (**C181** = [Inactive]), it is not necessary to open and close the **ENABLE** contact; Speed searching matches with the **RESET** command.

## 33.2. List of Parameters from C245 to C248

Table 75: List of Parameters C245 ÷ C248

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C245 | Speed Searching enabling | ENGINEERING | 1245 | 1: YES |
| C246 | Speed Searching disabling if ENABLE is open | ENGINEERING | 1246 | 1sec |
| C247 | Speed searching time as % deceleration ramp | ENGINEERING | 1247 | 10% |
| C248 | Speed searching current used | ENGINEERING | 1248 | 75% |
| C249 | Speed searching starting level | ENGINEERING | 1249 | Last speed |

C245 Speed Searching Enabling

| C245 | | | |
|---|---|---|---|
| | Range | 0 ÷ 1 | 0: No ÷ 1: Yes |
| | Default | 1 | 1: Yes |
| | Level | ENGINEERING | |
| | Address | 1245 | |
| | Control | IFD | |
| | Function | Enables speed searching.<br>The Speed Searching function is enabled in the following cases:<br>– when the **ENABLE** contact is open and closed before time $t_{SSdis}$ (**C246**);<br>– when the DC Braking command is disabled before the preset time is over (see DC BRAKING MENU);<br>– when an alarm is reset (with a reference other than 0) before time $t_{SSdis}$. | |

C246 Speed Searching disabling if ENABLE is open

| C246 | | | |
|---|---|---|---|
| | Range | 0; 3000 | 0 : (Always ON) ÷ 3000 sec |
| | Default | 1 | 1 sec |
| | Level | ENGINEERING | |
| | Address | 1246 | |
| | Control | IFD | |
| | Function | Determines the maximum allowable time passing between the inverter disabling and enabling when the Speed Searching function is activated. When the inverter is restarted, output frequency will depend on the preset acceleration ramp. When **C246** = 0: (Always ON) , speed searching will always occur, regardless of the time passing between the inverter disabling and enabling. | |

C247 Speed searching time as % deceleration ramp

| C247 | | | |
|---|---|---|---|
| | Range | 1 ÷ 1000 | 1 ÷ 1000% |
| | Default | 10 | 10% |
| | Level | ENGINEERING | |
| | Address | 1247 | |
| | Control | IFD | |
| | Function | Determines the speed searching time, expressed as a percentage of the deceleration ramp. | |

C248 Speed Searching Current Used

| C248 | | | |
|---|---|---|---|
| | Range | 20; MIN [105%; ((Imax inverter/Inom.motor)*100)%] | |
| | Default | 75 | 75% |
| | Level | ENGINEERING | |
| | Address | 1248 | |
| | Control | IFD | |
| | Function | Determines the max. current level for speed searching; it is expressed as a percentage of the motor rated current. | |

C249 Speed searching starting level

| C249 | | | |
|---|---|---|---|
| | Range | 0 ÷ 3 | 0: Last speed<br>1: VelMax / Ult.dir.<br>2: VelMax / Dir.pos.<br>3: VelMax / Dir.neg. |
| | Default | 0 | 0: Last speed |
| | Level | ENGINEERING | |
| | Address | 1249 | |
| | Control | IFD | |
| | Function | The speed searching function begins its search according to **C249** programming.<br>With the default setting, the speed searching starting level is the last speed produced before disabling. By setting **C249 = 1:[VelMax / Ult.dir.]** the maximum speed programmed for the motor will be produced in the last rotation direction produced. By setting **C249 = 2:[Vel Max/Dir.pos.]** regardless of the last frequency produced before disabling, the search will start from the maximum programmed motor speed in positive rotation direction, if **C249 : 3:[VelMax / Dir.neg]** the direction will be negative. | |

# 34. AUTORESET MENU

## 34.1. Overview

The Autoreset function can be enabled in case an alarm trips. You can enter the maximum number of autoreset attempts and the time required for resetting the attempt number. If the Autoreset function is disabled, you can program an autoreset procedure at power on, which resets an active alarm at the inverter power off. Undervoltage alarms or mains loss alarms can be saved in the fault list in the Autoreset menu.
To activate the Autoreset function, set a number of attempts other than zero in parameter **C255**. If the number of attempts is reset within a time interval t < **C256** is equal to the value set in **C255**, the autoreset function is disabled; it will be enabled again only when a time longer than or equal to **C256** has passed.
If the inverter is turned off when an alarm is active, the alarm trip is stored to memory and will be active at next power on. Regardless of the Autoreset function setup, an automatic reset of the last alarm stored can be obtained when the inverter is turned on (**C257** [Yes]). Undervoltage alarm **A47** (DC bus voltage below allowable threshold with motor running) or Mains Loss alarm **A64** (mains loss when the motor is running and the Power Down function is disabled) are not stored in the fault list when the inverter is powered off (factory-setting). To enable parameter storage, set **C258** to [Yes].

## 34.2. List of Parameters from C255 to C258

Table 76: List of Parameters C255 ÷ C258

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C255 | Autoreset attempt number | ENGINEERING | 1255 | 0 |
| C256 | Attempt counting reset time | ENGINEERING | 1256 | 300 sec |
| C257 | Alarm reset at Power On | ENGINEERING | 1257 | 0: [Disabled] |
| C258 | Enabling saving Undervoltage an d Mains Loss alarms | ENGINEERING | 1258 | 0: [Disabled] |

C255 Autoreset Attempt Number

| C255 | | | |
|---|---|---|---|
| | Range | 0 ÷ 100 | 0: ÷ 100 |
| | Default | 0 | 0 |
| | Level | ENGINEERING | |
| | Address | 1255 | |
| | Function | If set different from Disable (Disable = 0), this parameter enables the Autoreset function and sets the max. number of reset attempts for a time interval set in C256. If a time equal to the time set in C256 passes starting from the last alarm tripped, the autoreset attempt count is reset. | |

C256 Attempt Counting Reset Time

| C256 | | | |
|---|---|---|---|
| | Range | 0; 1000 | 0; 1000 sec. |
| | Default | 300 | 300 sec. |
| | Level | ENGINEERING | |
| | Address | 1256 | |
| | Function | Determines the time that passes from the last alarm tripped to reset the autoreset attempt number. | |

C257 Alarm Reset at Power On

| C257 | | | |
|---|---|---|---|
| | Range | 0; 1 | 0: [Disabled]; 1: [Yes] |
| | Default | 0 | 0: [Disabled] |
| | Level | ENGINEERING | |
| | Address | 1257 | |
| | Function | At power on, this parameter enables the automatic reset of the alarms tripped at the inverter power off. | |

C258 Enabling Saving Undervoltage and Mains Loss Alarms

| C258 | | | |
|---|---|---|---|
| | Range | 0; 1 | 0: [Disabled]; 1: [Yes] |
| | Default | 0 | 0: [Disabled] |
| | Level | ENGINEERING | |
| | Address | 1258 | |
| | Function | This parameter saves Undervoltage and Mains Loss alarms to the fault list. | |

# 35. MOTOR THERMAL PROTECTION MENU

## 35.1. Overview

The Motor Thermal Protection function protects the motor against overloads.
Some Sinus Penta models offer the possibility to set the heatsink temperature for the activation of cooling fans.
All relevant parameters are included in the Motor Thermal Protection submenu menu.

**NOTE**

Each connected motor has its own thermal model.
If the inverter is used to control only one motor and its control mode is selected through the selection of the different motors, the motor thermal protection is ensured by setting PTC protection for all motors.

For each programmable motor, thermal protection can be configured in 5 modes, which can be selected with parameter **C265** (motor 1), **C268** (motor 2) and **C271** (motor 3).

| | | |
|---|---|---|
| **0:NO** | **[NO]** | The Motor Thermal Protection function is disabled (factory-setting); |
| **1:YES** | **[No Derated]** | The Motor Thermal Protection function is active with pick-up current independent of operating speed; |
| **2:YES A** | **[Forced Cooled]** | The Motor Thermal Protection function is active with pick-up current depending on operating speed, with fan-cooled motor de-rating; |
| **3: YES B** | **[Self Cooled]** | The Motor Thermal Protection function is active; pick-up current depends on operating speed and de-rating is suitable for motors having a fan keyed to the shaft. |
| **4: PTC** | **[PTC]** | Thermoswitch on analog input AIN2 (for PTC features, see Sinus Penta Installation Instructions manual). |

Heating of a motor where constant current $I_O$ flows depends on current and time:

$$\theta(t) = K \cdot I_O^2 \cdot (1 - e^{-t/T})$$

where T is the motor thermal time constant (Motor 1 ← **C267**; Motor 2 ← **C270**; Motor 3 ← **C273**).
The motor heating is proportional to the square of RMS current flowing through the motor ($I_0^2$).
Alarm **A75** (Motor overheated) relating to thermal protection modes different from PTC trips when current flowing through the motor makes the motor temperature exceed the allowable asymptotic value set with It (pick up current: Motor 1 ← **C266**; Motor 2 ← **C269**; Motor 3 ← **C272**). Alarm **A75** can be reset after a time depending on the motor thermal constant, allowing for the motor cooling.
In thermal protection mode from PTC, alarm PTC (**A55**) trips when voltage acquired by input AIN2 used as a PTC signal input exceeds a preset threshold value when characteristic temperature is attained. Alarm **A55** can be reset only if temperature decreases by 5°C with respect to trip temperature.

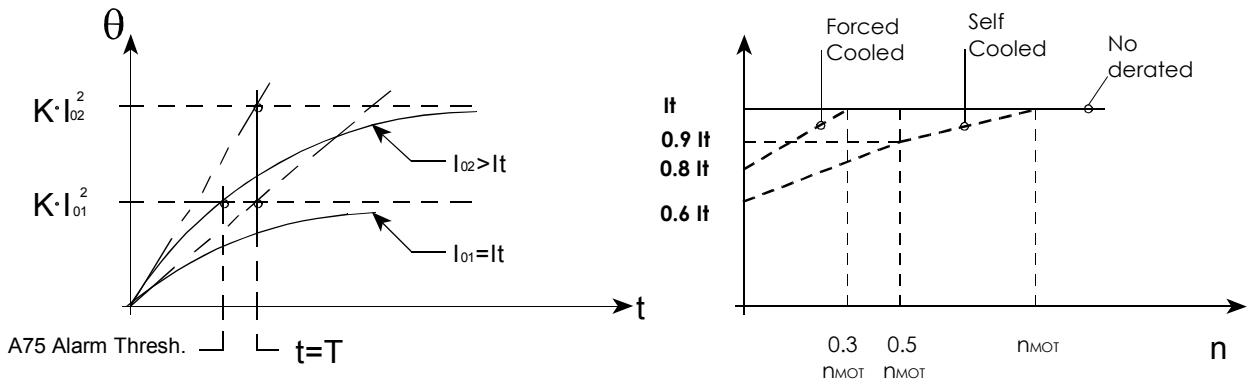



Figure 48: Motor Heating Patterns

Motor heating with two different current values ($I_{01}$ and $I_{02}$) that are kept constant in time and pick-up current It of thermal protection depending on speed output based on parameter **C265** for motor 1 (**C268** for motor 2 and **C271** for motor 3).

If motor thermal time constant τ is not known, you can enter a value equal to 1/3 of the time when motor temperature is supposed to be kept constant.

The suggested values if using a motor from Elettronica Santerno are as follows.

| Size | 2 pole | 4 pole | >4pole |
|---|---|---|---|
| S05-S15 | 900-1200sec | 1500-1800sec | 2400-3000sec |
| S20-S40 | tbf | tbf | tbf |
| >S50 | tbf | tbf | tbf |

**Table 77: Motor thermal time constant suggested values**

If a motor is being used from another manufacturer, the above values can be used as a guide only, however the correct values should be checked with the manufacturer.

## 35.2. List of Parameters from C264 to C273

**Table 78: List of Parameters C264 ÷ C273**

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Value |
|---|---|---|---|---|
| C264 | Heatsink temperature for fan activation | ADVANCED | 1264 | 50°C |
| C265 | Thermal Protection activation for motor 1 | BASIC | 1265 | 0:[Disabled] |
| C266 | Pick-up current for motor 1[Inom%] | ADVANCED | 1266 | 120% |
| C267 | Thermal time constant for motor 1 | BASIC | 1267 | 600s |
| C268 | Thermal Protection activation for motor 2 | ADVANCED | 1268 | 0:[Disabled] |
| C269 | Pick-up current for motor 2 [Inom%] | ADVANCED | 1269 | 120% |
| C270 | Thermal time constant for motor 2 | ADVANCED | 1270 | 600s |
| C271 | Thermal Protection activation for motor 3 | ADVANCED | 1271 | 0:[Disabled] |
| C272 | Pick-up current for motor 3 [Inom%] | ADVANCED | 1272 | 120% |
| C273 | Thermal time constant for motor 3 | ADVANCED | 1273 | 600s |

**C264 Heatsink Temperature for Fan Activation**

| C264 | | | |
|---|---|---|---|
| | Range | -1 ÷ 100 | -1: [Always ON] ÷ 100°C |
| | Default | 50 | 50°C |
| | Level | ADVANCED | |
| | Address | 1264 | |
| | Function | The heatsink cooling fans are switched on each time the inverter is enabled (and the IGBT commute). When disabled, the fans are switched off only if the heatsink temperature is less than **C264**.<br>Set "Always ON" for cooling fan continuous operation.<br>The real temperature of the heatsink can be displayed in measure parameter **M064**. | |

**NOTE** This parameter has effect only for models where fans are controlled directly by the inverter control board (N): the information can be deduced from the product screen in the IDP Menu.

Display

```
P R O D U C T   N A M E
P E N T A
t y p e   0 0 2 0   4 T   N
```

The last field of line 3 shows a code relating to the type of fan operation:

- _ : Fans are not controlled by control board ES821
- S : Control board ES821 detects the correct operation of the cooling fans; in cause of fan fault, the relevant alarm trips.
- P : Fan activation depends on the thermoswitch condition detected by the control board.
- N : The temperature sensor controlling the fan operation is an NTC. Temperature is measured by control board ES821 (**M064**); the threshold for switching off the fans when the inverter is disabled set in parameter **C264**. In this case only, fan activation depends on parameter **C264**.

## C265 (C268, C271) Thermal Protection Activation

| | | | |
|---|---|---|---|
| C265 (motor 1)<br>C268 (motor 2)<br>C271 (motor 3) | Range | 0; 4 | 0 : [Disabled]<br>1 : [No Derating]<br>2 : [Fan Cooled]<br>3 : [Fan Keyed to Shaft]<br>4 : [PTC] |
| | Default | 0 | 0 : [Disabled] |
| | Level | BASIC (C265); ADVANCED (C268, C271) | |
| | Address | 1265; 1268; 1271 | |
| | Function | This parameter enables the Motor Thermal Protection function.<br>It also selects the type of thermal protection among 3 different patterns and PTC mode (analog input AIN2). | |

## C266 (C269, C272) Pick-up Current

| | | | |
|---|---|---|---|
| C266 (motor 1)<br>C269 (motor 2)<br>C272 (motor 3) | Range | 1 ÷ min [120%; [((Imax/Imot)*100) %] | |
| | Default | 120 | 120% |
| | Level | ADVANCED | |
| | Address | 1266, 1269, 1272 | |
| | Function | This parameter determines the thermal protection pick-up current expressed as a percentage of the rated current<br>of motor 1 (2, 3) | |

## C267 (C270, C273) Thermal Time Constant

| | | | |
|---|---|---|---|
| C267 (motor 1)<br>C270 (motor 2)<br>C273 (motor 3) | Range | 1 ÷ 10800 | 1 ÷ 10.800 s |
| | Default | 600 | 600 s |
| | Level | BASIC (C267); ADVANCED (C270, C273) | |
| | Address | 1267; 1270; 1273 | |
| | Function | This parameter determines the thermal time constant of the motor. With a constant load function for 5 times this constant, the motor reaches a thermal constant. | |

# 36. PID CONFIGURATION MENU

## 36.1. Overview

The Sinus Penta is provided with a PID (Proportional, Integral, Derivative) regulator which makes it possible to perform regulation loops such as pressure control, delivery control, etc., without connecting to external auxiliary devices.
The PID Configuration Menu defines configuration parameters for the PID regulator.
The configuration parameters for the PID regulator can be modified only when the inverter is on stand-by and set the following variables: reference sources, feedback sources and type of PID output implementation.
The programming parameters for the PID regulator, including coefficients of proportional, integral and derivative terms, output saturation, etc., are covered in PID PARAMETERS MENU.

## 36.2. Operation and Structure of the PID Regulator

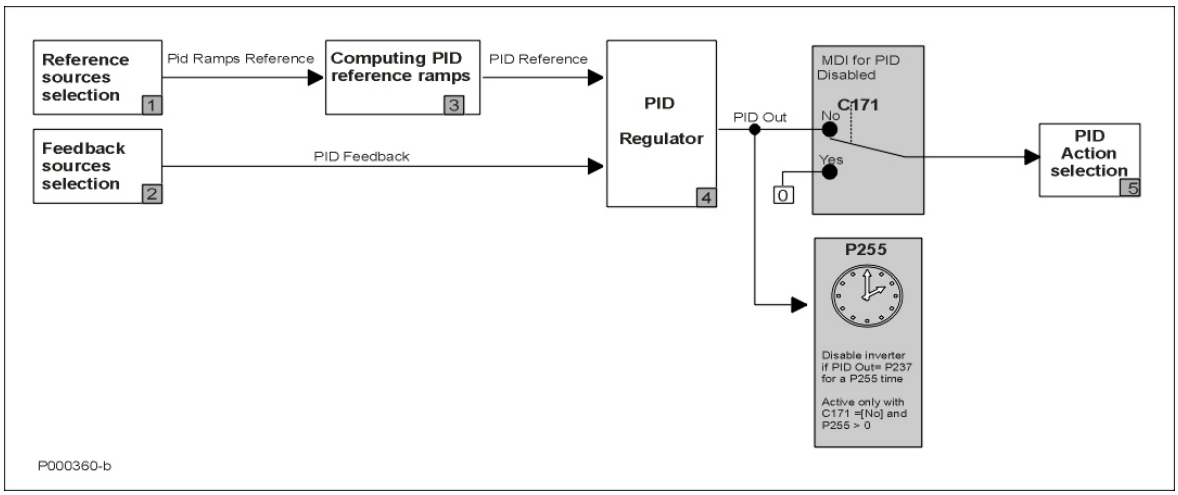



Figure 49: Structure of the PID Regulator

The above figure illustrates a block diagram of the PID regulator. Each block will be analysed in the sections that follow.
First, select the sources for the PID reference (block 1). Three different sources may be configured, for which their sum shall be considered. The same applies to the feedback sources (block 2).

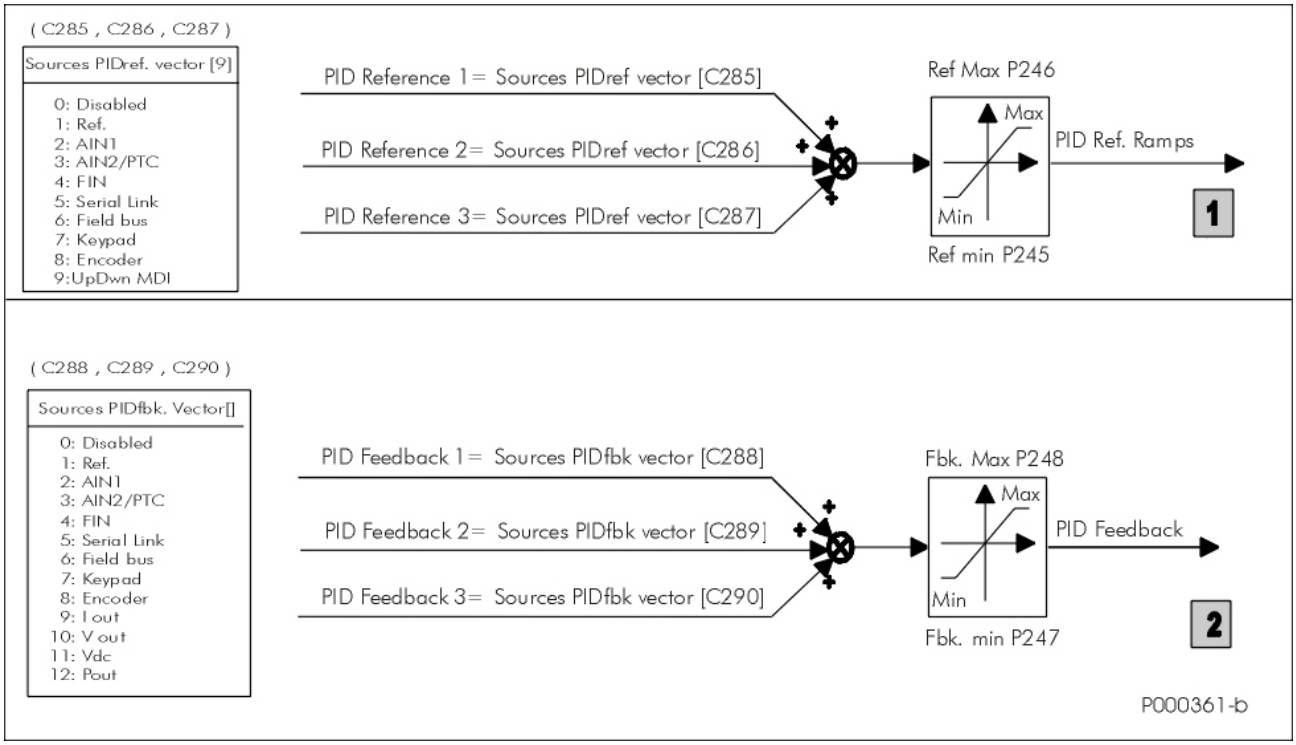



**Figure 50: Reference Source and Feedback Source Selection**

**NOTE** The signals selected in the Sources Vector are to be considered as percentage values, therefore analog signals are expressed as a percentage of the preset maximum values and minimum values. For example, in selecting as a reference source if **P052** Ref. max. = 8V and **P051** Ref. min. = –3V, 100% will be considered when Ref. = 8V and –100% will be considered when Ref. = –3V.

**NOTE** Among the allowable variables for PID feedback, it is also possible to select electrical variables Iout (output current), Vout (output voltage), Pout (output power) and Vdc (DC bus voltage). Their percentage values relate respectively to rated current values and rated voltage values of the selected motor and to 1500VDC.

**NOTE** In Local mode if the PID regulator is set as **C294 = Reference Sum otherwise the voltage sum will be disabled.**

Reference Source and Feedback selection.

| | |
|---|---|
| 0: Disable | Disabled |
| 1: REF | Analog input REF |
| 2: AIN1 | Analog input AIN1 |
| 3: AIN2/PTC | Analog input AIN2 |
| 4: Pulse Input | Frequency Input |
| 5: Serial Link | Serial Link |
| 6: Fieldbus | Field Bus |
| 7: Keypad | Keypad |
| 8: Encoder | Encoder input |
| 9: Iout | Output current |
| 10: Vout | Output voltage |
| 11: Vdc | DC voltage of DC-link |
| 12: Pout | Output power |

NOTE: Selections 9÷11 are available for feedback only.

A ramp (block 3) may be applied to the PID setpoint output of block 1. The processed reference is the one actually used by the PID regulator. The parameters of the PID reference ramp are illustrated in the figure below. The initial rounding-off is applied to the reference whenever a new acceleration/deceleration ramp is started, whilst the end reference is applied at the end of each ramp.

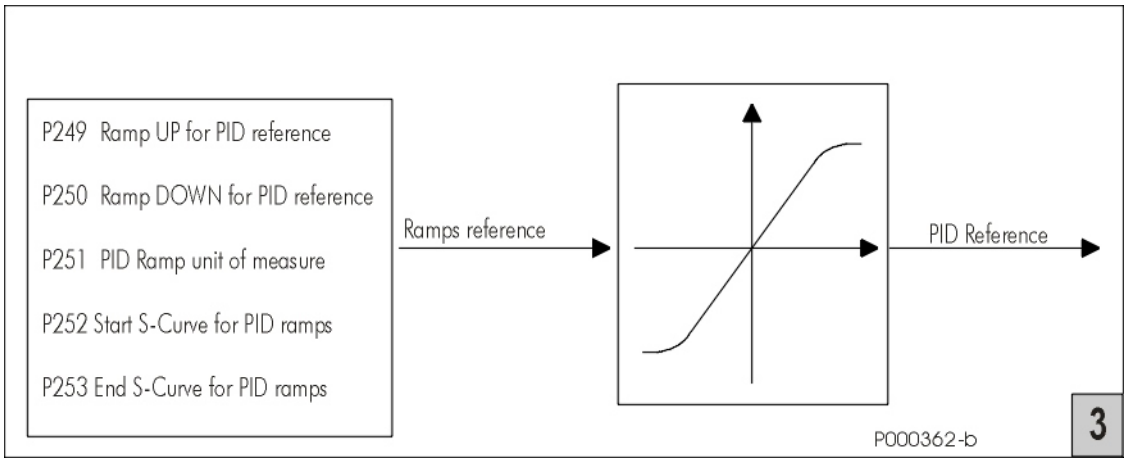

P249 Ramp UP for PID reference
P250 Ramp DOWN for PID reference
P251 PID Ramp unit of measure
P252 Start S-Curve for PID ramps
P253 End S-Curve for PID ramps
Ramps reference
PID Reference
P000362-b
3

**Figure 51: PID Ramp Reference**

Block 4 is the real PID regulator. The output may be disabled by an external digital command (if properly programmed). If the PID regulator is used as a reference source and **P255** not set at zero, the PID output value control is enabled. If the PID output equals the preset minimum value for a time longer than **P255**, the inverter is automatically put on stand-by. In block 5, the PID output is applied to the function defined by the "Regulator Implementation" parameter (**C294**).
The PID regulator structure is detailed in the diagram below (block 4).

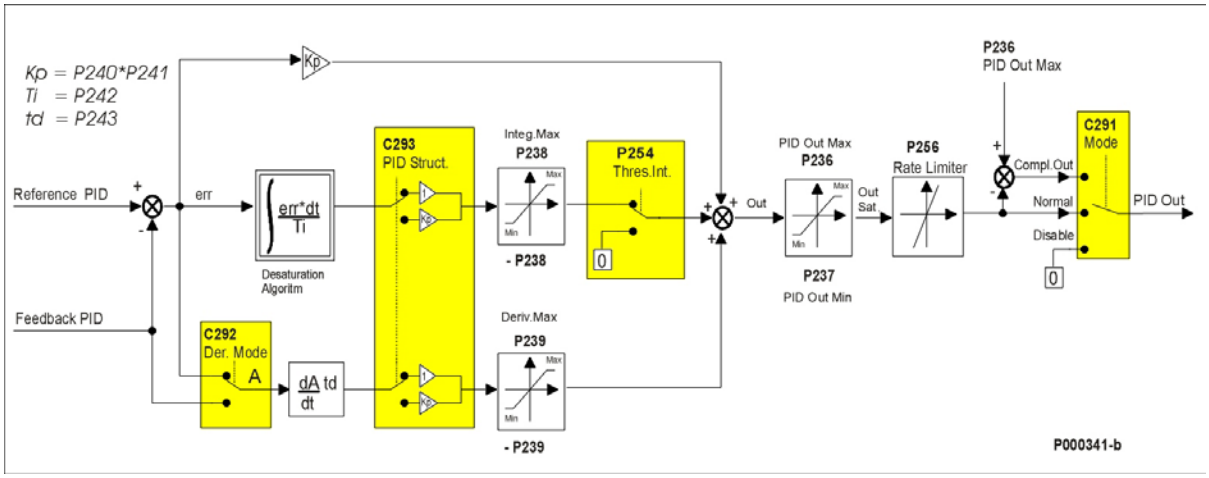



Figure 52: Details of the PID Regulator Structure

The PID regulator output may be used as:

- an external output;
- a speed/torque reference of the inverter;
- a speed/torque reference increase or, if the IFD control is used, the PID regulator input may be used for correcting the output voltage.

If the PID regulator output is the speed reference of the inverter, the selected speed/torque ramp is applied.

## 36.3. List of Parameters from C285 to C294

Table 79: List of Parameters C285 ÷ C294

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| C285 | PID reference selection no. 1 | ENGINEERING | 1285 | 2:AIN1 |
| C286 | PID reference selection no. 2 | ENGINEERING | 1286 | 0:Disable |
| C287 | PID reference selection no. 3 | ENGINEERING | 1287 | 0:Disable |
| C288 | PID Feedback selection no.1 | ENGINEERING | 1288 | 3:AIN2/PTC |
| C289 | PID Feedback selection no.2 | ENGINEERING | 1289 | 0:Disable |
| C290 | PID Feedback selection no.3 | ENGINEERING | 1290 | 0:Disable |
| C291 | PID functioning mode | ENGINEERING | 1291 | 0:Disable |
| C292 | Quantity selection to compute Derivative term | ENGINEERING | 1292 | 0:Measure |
| C293 | Proportional Multiplier of derivative and integral terms | ENGINEERING | 1293 | 0:NO |
| C294 | PID implementation | ENGINEERING | 1294 | 1:Reference |

C285 (C286,C287) PID Reference selection no.1 ( 2, 3)

| | | | |
|---|---|---|---|
| C285 (C286, C287) | Range | 0 ÷ 8 | 0: Disable<br>1: REF<br>2: AIN1<br>3: AIN2/PTC<br>4: Pulse Input<br>5: Serial Link<br>6: Fieldbus<br>7: Keypad<br>8: Encoder |
| | Default | **C285** = 2<br>**C286** = 0<br>**C287** = 0 | **C285** = 2: AIN1<br>**C286** = 0<br>**C287** = 0 |
| | Level | ENGINEERING | |
| | Address | 1285, 1286, 1287 | |
| | Function | **C285** selects the first PID reference source from the PID regulator. Up to three reference sources may be configured **(285 – C287)** considered as a sum.<br>The sources are used by the PID and are expressed in percentage values (with reference to their max. value and min. value set in the References menu).<br>If multiple reference sources are selected, their sum is considered. They are saturated between **P246** and **P245** (PID reference maximum and minimum value respectively). | |

C288 (C289,C290) PID Feedback selection no.1 (2, 3)

| | | | |
|---|---|---|---|
| C288 (C289, C290) | Range | 0 ÷ 11 | 0: Disable<br>1: REF<br>2: AIN1<br>3: AIN2/PTC<br>4: Pulse Input<br>5: Serial Link<br>6: Fieldbus<br>7: Keypad<br>8: Encoder<br>9: Iout<br>10: Vout<br>11: Vdc<br>12: Pout |
| | Default | **C288**= 3<br>**C289**= 0<br>**C290**= 0 | **C288**= 3: AIN2/PTC<br>**C289**= 0: Disable<br>**C290**= 0: Disable |
| | Level | ENGINEERING | |
| | Address | 1288, 1289, 1290 | |
| | Function | **C288** selects the first PID feedback source. Up to three feedback sources can be configured among the eleven reference sources available. If multiple sources are selected, their sum is considered. They are saturated based on parameters **P247** and **P248** (PID reference maximum and minimum value respectively). The same considerations apply as **C285**. | |

C291 PID Functioning mode

| C291 | Range | 0 ÷ 2 | 0: Disable<br>1: Normal<br>2: Compl. Out |
|---|---|---|---|
| | Default | 0 | 0: Disable |
| | Level | ENGINEERING | |
| | Address | 1291 | |
| | Function | This parameter defines how to compute the PID output.<br>Three computing modes are available: 0: **Disable**, 1: **Normal**, 2: **Compl. Out**.<br>If 0:**Disable** is selected, the PID regulator is inactive and its output is always set to zero.<br>In the **Normal** mode, the real PID output is considered.<br>If 2:**Compl.Out** (complemented output) is selected, the output implemented by the PID regulator results from the subtraction of the max. output value set in **P236** from the output obtained by the PID regulator.<br>This operating mode can be used for special applications (see the Keeping Fluid Level Constant (Example) at the end of this chapter). | |

C292 Quantity Selection to Compute Derivative term

| C292 | Range | 0 ÷ 1 | 0: Measure<br>1: Error |
|---|---|---|---|
| | Default | 0 | 0: Measure |
| | Level | ENGINEERING | |
| | Address | 1292 | |
| | Function | This parameter sets the variable used for calculating the derivative term.<br>By default, the derivative term is computed according to the feedback measure, but it can also be computed according to the PID error:<br>Error = Reference – Feedback. | |

C293 Proportional Multiplier of derivative and integral terms

| C293 | Range | 0 ÷ 1 | 0: No<br>1: Yes |
|---|---|---|---|
| | Default | 0 | 0: No |
| | Level | ENGINEERING | |
| | Address | 1293 | |
| | Function | This parameter defines whether the proportional term is also used for the multiplication of the derivative and integral terms.<br>0: No means that the proportional term DOES NOT also multiply the integral term. | |

## C294 PID implementation

| | | | |
|---|---|---|---|
| C294 | Range | 0 ÷ 3 | 0: Analog output<br>1: Reference<br>2: Reference sum.<br>3: Voltage sum |
| | Default | 1 | 1: Reference |
| | Level | ENGINEERING | |
| | Address | 1294 | |
| | Function | This parameter sets the type of implementation carried out by the PID regulator.<br>***C294*** *= Analog Output:* The PID regulator is independent of the inverter operation, unless a digital input is configured for PID disabling; if the digital input closes, the PID regulator is disabled and the output is reset to zero. In order to use the PID regulator output outside the drive, configure one of the analog outputs as PID Out.<br>***C294*** *= Reference:* The PID regulator output is the speed/torque reference of the connected motor (depending upon the type of reference configured when the motor is running), any other reference source which is selected will be ignored. If the output is a speed reference, 100% corresponds to the max. absolute value between min. speed and max. speed set for the motor being used.<br>Mot1 <– Max { \| **C028** \|; \| **C029** \| }<br>Mot2 <– Max { \| **C071** \|; \| **C072** \| }<br>Mot3 <– Max { \| **C114** \|; \| **C115** \| }<br><br>Whereas, if 100% relates to a torque value, this is the max. absolute value between the min. limit and the max. limit of the torque of the active motor.<br><br>Mot1 <– max { \| **C047** \|; \| **C048** \| }<br>Mot2 <– max { \| **C090** \|; \| **C091** \| }<br>Mot3 <– max { \| **C133** \|; \| **C134** \| }<br><br>***C294*** *= Reference Sum:* The PID regulator output is a correction of the speed/torque reference of the active motor(depending upon the type of reference configured when the motor is running). The percentage value of the PID output relates to the instant value of the speed/torque reference. For example, if the speed reference of the active motor is 800rpm and the PID output is ignored, if this drops to 50%, the overall speed setpoint will be 800 + 800*(50/100) = 1200rpm. therefore, the reference sign can never be reversed by the PID regulator.<br>***C294*** *= Voltage Output Sum:* This configuration is active only when the control algorithm of the active motor is the Voltage/Frequency. In this case, the PID regulator output is a correction of the output voltage. The percentage value of the PID output relates to the instant voltage value. For example, if a motor is in the Voltage/Frequency mode and at 25 Hz the inverter output voltage is 200V rms with a PID implementation = 0, if the PID implementation drops to –10%, the implemented voltage will be 200 + 200*(–10/100) = 180V. | |

## 36.4. Keeping Fluid Level Constant (Example)

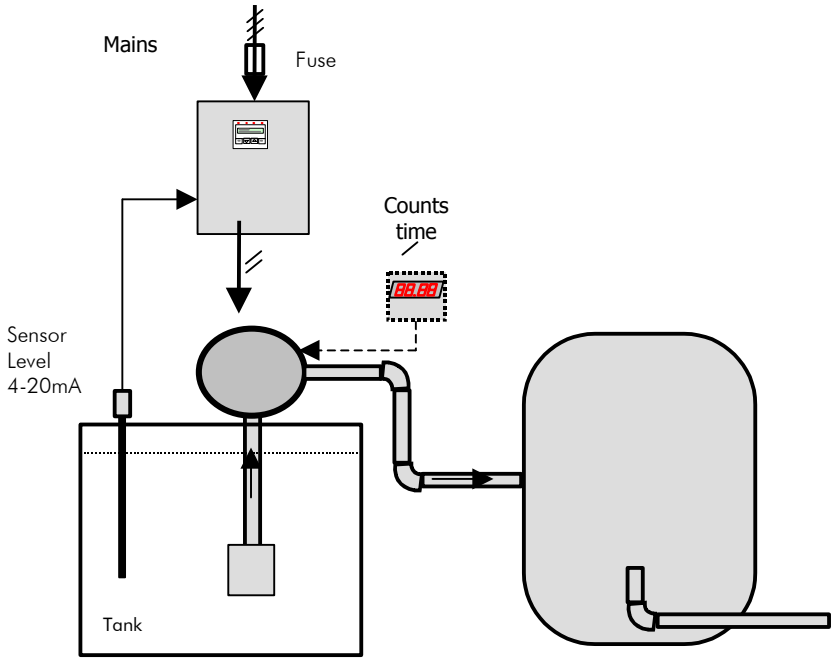



Figure 53: Keeping fluid level constant (Example)

Suppose that the maximum level in the tank is to be kept at 50% and that a 4–20mA level probe is used, with an output of 4mA with the min. level and 20mA with the max. level. The PID reference is sent from keypad, while the probe feedback is sent to analog input AIN2/PTC, which is configured as follows:

| | | |
|---|---|---|
| P060-Type of Reference for Input AIN2/PTC | 2: 4-20mA | |
| P061-Reference Minimum Value for Input AIN2/PTC | 4.0 | mA |
| P062-Reference Maximum Value for Input AIN2/PTC | 20.0 | mA |
| P063-Offset for Input AIN2/PTC | 0.000 | mA |
| P064-Filter AIN2/PTC Constant | 1 | ms |

The reference shall be saved from keypad, so as to avoid setting up again when the drive is shut off.

| | |
|---|---|
| P068-Storage of UP/DN and KPD Reference | 1: Yes |
| P068a-Reset of Speed/Torque UP/DN value at Stop | 0: No |
| P068b-Reset of PID UP/DN value at Stop | 0: No |
| P068c-Reset of Speed/Torque UP/DN value at Source Selection | 0: No |
| P068d-Reset of PID UP/DN value at Source Selection | 0: No |
| P069-Amplitude of UP/DN and KPD Reference | 1: Unipolar |

The PID regulator implementation and the PID output calculating mode must also be set.

| | | |
|---|---|---|
| R W S | C285-Selection of Reference Type 1 PID | 7: Keypad |
| R W S | C286-Selection of Reference Type 2 PID | 0: Disabled |
| R W S | C287-Selection of Reference Type 3 PID | 0: Disabled |
| R W S | C288-Selection of Feedback Type 1 PID | 3: AIN2/PTC |
| R W S | C289-Selection of Feedback Type 2 PID | 0: Disable |
| R W S | C290-Selection of Feedback Type 3 PID | 0: Disable |
| R W S | C291-PID Operating Mode | 2: Compl.Out |
| R W S | C292-Quantity Selection to Compute Derivative Term | 0: Measure |
| R W S | C293-Kp Used as a Multiplier for Integral and Derivative Terms | 1: Yes |
| R W S | C294-PID Operation | 1: Reference |

The PID regulator parameters are defined in the PID Parameters menu below. This configuration limits the PID output between 0 and 100% for a proper rotation of the connected pump. Set **P255** = 1000 ts: if the PID output is equal to the min. value for 5 seconds, the inverter is put on stand by.

| | | | |
|---|---|---|---|
| R W S | P236-PID Maximum Output | 100.00 | % |
| R W S | P237-PID Minimum Output | 0.00 | % |
| R W S | P238-Maximum Value of PID Integral Term | 100.00 | % |
| R W S | P239-Maximum Value of PID Derivative Term | 100.00 | % |
| R W S | P240-Proportional Coefficient Value | 5.000 | |
| R W S | P241-Proportional Term Multiplicative Factor | 0: 1 | |
| R W S | P242-Integral Time (Multiples of Ts) | 500 | Ts [ms Disabled |
| R W S | P243-Derivative Time (Multiples of mTs) | 0 | Ts [ms] |
| R W S | P244-Cycle Time Ts | 5 | ms |
| R W S | P245-PID Reference Min. Value | -100.00 | % |
| R W S | P246-PID Reference Max. Value | 100.00 | % |
| R W S | P247-PID Feedback Minimum Value | -100.00 | % |
| R W S | P248-PID Feedback Maximum Value | 100.00 | % |
| R W S | P249-Reference Ramp UP Acceleration Time | 0.00 | s |
| R W S | P250-Reference Ramp DOWN Deceleration Time | 0.00 | s |
| R W S | P251-Unit of Measure of Reference Ramp UP/DOWN | 2: 1 s | |
| R W S | P252-Start S-Curve for PID ramps | 1 | % |
| R W S | P253-End S-Curve for PID ramps | 1 | % |
| R W S | P254-PID Out Threshold Enabling Integral Implem. | 0.0 | %\|Refmax\| |
| R W S | P255-Inverter Disabling Time for PID Output Equal to Min. Value | 1000 | s Disabled |
| R W S | P256-Time Spent by PID Output from 0% to 100% | 1 | ms |
| R W S | P257-Gain for PID Measure Scaling | 1.000 | |

When the level of liquid in the tank exceeds the reference value set from the keypad, a negative error is produced (Error = Reference – Feedback). Because the complemented output computing mode is selected and because the complemented output is the speed reference, the higher the error absolute value, the higher the PID output value. This means that the quicker the level increases, the quicker the pump suction. Whereas, if the level is lower than the reference, a positive error is produced, because the PID output is limited to 0%, the pump will not activate, if the PID output is equal to the min. value for a timer longer than **P255** = 1000***P244** = 5sec , the inverter is put on stand by.

# 37. BRIDGE CRANE MENU

## 37.1. Overview

For lifting applications, it may be necessary to consider the opening/closing of a mechanical brake in order to obtain a proper control of the connected motor.
For example, if a mechanical brake takes 500msec to open after the start command, the delay is due to the type of brake, therefore during 500msec, the motor will not be running, while the speed reference increases the preset ramp. The motor then pushes against the brake, and when it can rotate freely, the motor torque will not match with the torque required to move the connected load.
If the speed setpoint is kept at zero for a given time after sending the start command (considering the time required for the mechanical brake to open), the motor control will implement the proper torque for the motor speed as soon as the motor can start rotating.
The brake closing may take place with a properly set digital input, thus when the inverter detects the brake closing, it automatically adjusts the value of the current injected into the motor to the fluxing value. This is required when, during the lifting stage, the mechanical brake closes when the load is suspended after reaching a speed that is practically at zero. In this case the motor torque output keeps the load suspended and because the motor is at a standstill, the brake closing has no effect on the speed regulator, and the inverter shall no longer produce the torque value required to keep the load suspended, as a result, the current injected into the motor drops to the value required for motor fluxing.

**NOTE** The Bridge CRANE menu is used for VTC and FOC Control only

**NOTE** To guarantee safety the contact of the successful brake closing must be exclusively of a NO type (close contact only when the brake is engaged).

**NOTE** In addition to parameters from C300 to C302, it has to be set a specific MDO as 6: BRAKE (see OUTPUT DIGITAL MENU)

## 37.2. List of Parameters from C300 to C302

Table 80: List of Parameters C300 ÷ C302

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| C300 | Pretensioning torque [%Cnom] | ENGINEERING | 1300 | 0.0% |
| C301 | Pretensioning time | ENGINEERING | 1301 | 0 |
| C302 | Closed Brake Input (contact NO) | ENGINEERING | 1302 | 0: None |

C300 Pretensioning Torque [%Cnom]

| C300 | | | |
|---|---|---|---|
| | Range | -5000 ÷ +5000 | -500.0% ÷ +500.0% |
| | Default | 0 | 0.0 % |
| | Level | ENGINEERING | |
| | Address | 1300 | |
| | Function | If not set at zero, this parameter defines the torque value (expressed as a percentage of the rated torque of the selected motor) reached before the speed ramp starts after sending a **START** command.<br>After sending a **START** command, the inverter takes the motor torque to the level set in **C300** and torque is adjusted by the speed loop for the time set in **C301** in order to keep the motor at a standstill. Once this time has elapsed, the speed ramp can start and the motor follows the required speed profile.<br>The torque sign defines the relative running direction. | |

C301 Pretensioning Time

| | | | |
|---|---|---|---|
| C301 | Range | 0 ÷ 32000 | 0 ÷ 32000 ms |
| | Default | 0 | 0 |
| | Level | ENGINEERING | |
| | Address | 1301 | |
| | Function | Delay time passing between the start command and the speed ramp start. During this time, the motor torque output is set in **C300** to keep the load suspended. | |

C302 Closed Brake Input (contact NO)

| | | | |
|---|---|---|---|
| C302 | Range | 0 ÷ 8 | 0: Disable<br>1: MDI1 (START)<br>2: MDI2 (ENABLE)<br>3: MDI3 (RESET)<br>4: MDI4<br>5: MDI5<br>6: MDI6<br>7: MDI7<br>8: MDI8 |
| | Default | 0 | 0: Disable |
| | Level | ENGINEERING | |
| | Address | 1301 | |
| | Function | This parameter determines the digital input assigned to the mechanical brake closing feedback (contact NO, closed only when brake is engaged). When the brake closing is detected after a deceleration ramp, current required for motor fluxing is injected into the motor. If no digital input is available for the detection of the brake closing, set max. time in **C183**, in order to avoid injecting current into the motor after the deceleration ramp. When the motor is not running, the **START** command is disabled and the speed setpoint is at zero for a longer time longer than that set in **C183**, the inverter will be put on standby. | |

# 38. SERIAL LINKS MENU

## 38.1. Overview

NOTE

Please refer to the Sinus Penta **Installation Manual** for the description of the serial links and connections.

NOTE

For a greater immunity against communication interference, an optional optoisolated serial board (ES822) may be used instead of serial link RS485. Lines RS232 and RS485 can interface with board ES822.
Please refer to the Sinus Penta **Installation Manual** for the description of the optional optoisolated board.

NOTE

The parameters described in this menu are R parameters.
Once changed and stored they become active only once the inverter is switched on again or when the control board is reset (by holding down the **RESET** key for more than 5 secs).

Inverters of the SINUS PENTA series may be connected to peripheral devices through a serial link. This enables both reading and writing of all parameters normally accessed through the display/keypad. Two-wire RS485 is used, which ensures better immunity against disturbance even on long cable paths, thus reducing the possibility for communication errors.

Two serial links are available. **Serial Link 0** is provided with a 9-pole, male D connector; **Serial Link 1** is provided with an RJ45 connector (or a threephone connector) connected to the display/keypad.

NOTE

The display/keypad connected through connector RJ45 dialogues correctly with the inverter using the default values preset in the parameter set of serial link 1.

The inverter will typically behave as a slave device (i.e. it only answers to queries sent by another device). A master device (typically a computer) is then needed to start serial communications.
The following items may be configured for both serial links:

1. The inverter MODBUS address.
2. The inverter response delay to a Master query.
3. The baud rate of the serial link (expressed in bits per second);
4. The time added to the 4 byte–time;
5. The serial link watchdog (which is active if the relevant parameter is not set at 0);
6. The type of parity used for serial communications.

NOTE

The parameters in this menu are of an R type.
Once saved, they are active only when the inverter is turned on again or offer a control board reset (pushing Reset for more than 5 sec).

### 38.1.1. WATCHDOG ALARMS

The Watchdog alarms determined by the serial link may be the following:

- **A061** Serial alarm n.0 WDG
- **A062** Serial alarm n.1 WDG
- **A081** Keypad Watchdog

The first two alarms trip when no legal message is sent from the serial link to the inverter for a time longer than the time set in the relevant watchdog parameters; **these alarms are active only if the relevant parameters are not set at zero.**
The third alarm trips only if the **display/keypad used as a reference/command source** detects a communication loss for a time longer than 2 seconds.

### 38.1.2. SPECIAL CODES

| Code | Name | Description |
|---|---|---|
| 0x01 | ILLEGAL FUNCTION | The function sent by the Master is different from 0x03 (Read Holding Registers) and from 0x10 (Preset Multiple Registers). |
| 0x02 | ILLEGAL ADDRESS | The reading/writing address used by the Master is illegal. |
| 0x03 | ILLEGAL DATA VALUE | The numerical value written by the Master is not included in the correct range. |
| 0x06 | DEVICE BUSY | The inverter did not acknowledge the Master's written values (for example, because it is running with a Cxxx parameter). |
| 0x07 | ANOTHER USER WRITING | Other users are writing values to the same parameter that the Master is trying to use (editing through display/keypad or Upload/Download from keypad). |
| 0x09 | BAD ACCESS LEVEL | The Master tried to write a parameter which is not included in the current access level (for example an ADVANCED parameter with a BASIC level). |

## 38.2. List of Parameters from R001 to R013

Table 81: List of Parameters R001 ÷ R013

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| R001 | Inverter MODBUS Address for Serial Link 0 (D9-pole) | ENGINEERING | 588 | 1 |
| R002 | Response Delay for Serial Link 0 (D9-pole) | ENGINEERING | 589 | 5msec |
| R003 | Baud Rate for Serial Link 0 (D9-pole) | ENGINEERING | 590 | 6:38400 bps |
| R004 | Time added to 4byte–time for Serial Link 0 (D9-pole) | ENGINEERING | 591 | 2msec |
| R005 | Watchdog time for Serial Link 0 (D9-pole) | ENGINEERING | 592 | 0.0sec |
| R006 | Parity Bit for Serial Link 0 (D9-pole) | ENGINEERING | 593 | 1:Disabled 2 Stop-bit |
| R008 | Inverter MODBUS address for Serial Link 1 (RJ45) | ENGINEERING | 595 | 1 |
| R009 | Response Delay for Serial Link 1 (RJ45) | ENGINEERING | 596 | 5 msec |
| R010 | Baud Rate for Serial Link 1 (RJ45) | ENGINEERING | 597 | 6:38400 bps |
| R011 | Time Added to 4byte–time for Serial link 1 (RJ45) | ENGINEERING | 598 | 2msec |
| R012 | Watchdog Time Serial Link 1 (RJ45) | ENGINEERING | 599 | 0.0sec |
| R013 | Parity Bit for Serial Link 1 (RJ45) | ENGINEERING | 600 | 1:Disabled 2 Stop-bit |

R001 Inverter MODBUS Address for Serial Link 0 (D9-pole)

| R001 | | | |
|---|---|---|---|
| | Range | 1 ÷ 247 | 1 ÷ 247 |
| | Default | 1 | 1 |
| | Level | ENGINEERING | |
| | Address | 588 | |
| | Function | This parameter determines the address assigned to the inverter connected through RS485 of serial link 0 (9-pole, male D connector). | |

R002 Response Delay for Serial Link 0 (D9-pole)

| .R002 | | | |
|---|---|---|---|
| | Range | 1 ÷ 1000 | 1 ÷ 1000 msec |
| | Default | 5 | 5 msec |
| | Level | ENGINEERING | |
| | Address | 589 | |
| | Function | This parameter determines the inverter response delay after a master query sent through serial link 0 (9-pole, male D connector). | |

R003 Baud Rate for Serial Link 0 (D9-pole).

| | | | |
|---|---|---|---|
| R003 | Range | 1 ÷ 7 | 1: 1200 bps<br>2: 2400 bps<br>3: 4800 bps<br>4: 9600 bps<br>5: 19200 bps<br>6: 38400 bps<br>7: 57600 bps |
| | Default | 6 | 6: 38400bps |
| | Level | ENGINEERING | |
| | Address | 590 | |
| | Function | This parameter determines the baud rate, expressed in bits per second, for serial link 0 (9-pole, male D connector). | |

R004 Time added to 4–Byte–Time for Serial Link 0 (D9-pole).

| | | | |
|---|---|---|---|
| R004 | Range | 1 ÷ 10000 | 1 ÷ 10000 msec |
| | Default | 2 | 2 msec |
| | Level | ENGINEERING | |
| | Address | 591 | |
| | Function | This parameter determines the limit time when no character is received from serial link 0 (9-pole, male D connector) and the message sent from the master to the inverter is considered as ended. | |

R005 Watchdog Time for Serial Link 0 (D9-pole).

| | | | |
|---|---|---|---|
| R005 | Range | 0 ÷ 60000 | 0 ÷ 6000.0 sec |
| | Default | 0 | 0.0 sec |
| | Level | ENGINEERING | |
| | Address | 592 | |
| | Function | If not set at zero, this parameter determines the time limit after which alarm **A61** WDG Serial 0 Alarm trips if the inverter does not receive any legal message through serial link 0 (9-pole, male D connector). | |

R006 Parity Bit for Serial Link 0 (D9-pole).

| | | | |
|---|---|---|---|
| R006 | Range | 0 ÷ 3 | 0: Disabled 1 Stop–bit<br>1: Disabled 2 Stop–bit<br>2: Even (1 Stop bit)<br>3: Odd (1 Stop bit) |
| | Default | 1 | 1: Disabled 2 Stop–bit |
| | Level | ENGINEERING | |
| | Address | 593 | |
| | Function | This parameter determines whether the parity bit is used or not when creating the MODBUS message through serial link 0 (9-pole, male D connector). | |

R008 Inverter MODBUS Address for Serial Link 0 (RJ45)

| | | | |
|---|---|---|---|
| R008 | Range | 1 ÷ 247 | 1 ÷ 247 |
| | Default | 1 | 1 |
| | Level | ENGINEERING | |
| | Address | 595 | |
| | Function | This parameter determines the address assigned to the inverter connected to the network through RS485 of serial link 1 (RJ45 connector). | |

**NOTE** The display/keypad connected through connector RJ45 dialogues correctly with the inverter using the default values preset in the parameter set of serial link 0 (RJ45).

R009 Response Delay for Serial Link 0 (RJ45).

| | | | |
|---|---|---|---|
| R009 | Range | 1 ÷ 1000 | 1 ÷ 1000 msec |
| | Default | 5 | 5 msec |
| | Level | ENGINEERING | |
| | Address | 596 | |
| | Function | This parameter determines the inverter response delay after a master query sent through serial link 0 (RJ45 connector). | |

R010 Baud Rate for Serial Link 0 (RJ45).

| | | | |
|---|---|---|---|
| R010 | Range | 1 ÷ 7 | 1: 1200 bps<br>2: 2400 bps<br>3: 4800 bps<br>4: 9600 bps<br>5: 19200 bps<br>6: 38400 bps<br>7: 57600 bps |
| | Default | 6 | 6: 38400bps |
| | Level | ENGINEERING | |
| | Address | 597 | |
| | Function | This parameter determines the baud rate, expressed in bits per second, for serial link 0 (RJ45 connector). | |

R011 Time Added to 4–Byte–Time for Serial Link 0 (RJ45).

| | | | |
|---|---|---|---|
| R011 | Range | 1÷10000 | 1 ÷ 10000 msec |
| | Default | 2 | 2 msec |
| | Level | ENGINEERING | |
| | Address | 598 | |
| | Function | This parameter determines the time limit when no character is received from serial link 0 (RJ45 connector) and the message sent from the master to the inverter is considered as ended. | |

R012 Watchdog Time for Serial Link 0 (RJ45).

| | | | |
|---|---|---|---|
| R012 | Range | 0 ÷ 60000 | 0 ÷ 6000.0 sec |
| | Default | 0 | 0.0 sec |
| | Level | ENGINEERING | |
| | Address | 599 | |
| | Function | If this parameter is not set at zero, it determines the time limit after which alarm **A62** WDG Serial Link 0 Alarm trips if the inverter does not receive any legal message through serial link 1 (RJ45 connector). | |

R013 Parity Bit for Serial Link 0 (RJ45).

| | | | |
|---|---|---|---|
| R013 | Range | 0 ÷ 3 | 0: Disabled 1 Stop–bit<br>1: Disabled 2 Stop–bit<br>2: Even (1 Stop bit)<br>3: Odd (1 Stop bit) |
| | Default | 1 | 1: Disabled 2 Stop–bit |
| | Level | ENGINEERING | |
| | Address | 600 | |
| | Function | This parameter determines whether the parity bit is used or not when creating the MODBUS message through serial link 0 (RJ45 connector). | |

# 39. FIELD BUS CONFIGURATION MENU

## 39.1. Overview

NOTE See paragraph FIELDBUS COMMUNICATION BOARDS in the **Installation Manual** for a description of the required optional board.

NOTE The parameters in this menu are of an R type.
Once saved, they are active only when the inverter is turned on again or offer a control board reset (pushing Reset for more than 5 sec).

## 39.2. List of Parameters from R016 to R017

Table 82: List of Parameters R016 ÷ R017

| Parameter | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| R016 | Field Bus Watchdog Time | ENGINEERING | 603 | 0 ms |
| R017 | Analog Outputs from the Field Bus AO1 AO2 AO3 | ENGINEERING | 604 | 000b |

R016 Field Bus Watchdog Time

| R016 | | | |
|---|---|---|---|
| | Range | 0 ÷ 60000 | 0 ÷ 60000 ms |
| | Default | 0 | 0 ms |
| | Level | ENGINEERING | |
| | Address | 603 | |
| | Function | If not set at zero, this parameter determines the time limit after which **A070** Field bus WDG trips (no legal writing is received from the field bus in a given time interval). | |

NOTE The Watchdog activates only once the inverter has received the first legal message from the master, according to the description in the paragraph ALARM A070 (COMMUNICATIONS SUSPENDED); this avoids untimely activation due to different start times between the master and the inverter.

R017 Analog Outputs controlled by the Field Bus

| R017 | | | |
|---|---|---|---|
| | Range | 000b ÷ 111b binary<br>0000h ÷ 0007h hex<br>0 ÷ 7 decimal | 000b → None<br>001b → AO1<br>010b → AO2<br>100b → AO3 |
| | Default | 000b | 000b → None |
| | Level | ENGINEERING | |
| | Address | 604 | |
| | Function | To select analog outputs controlled by the field bus, select the bit corresponding to the analog output to be controlled.<br>Example:<br>**R017** = 0011b = 3 decimal → analog outputs AO1 and AO2 are controlled directly by the field bus, **irrespective of their configuration in the Analog Output menu.** | |

## 39.3. EXCHANGED PARAMETERS

The tables below state the Sinus Penta parameters exchanged via Field Bus.

Each table contains:
1) the parameter code;
2) its description;
3) its range;
4) its unit of measure (also indicated on the display);
5) the ratio between the Sinus Penta value (exchanged via Field Bus) and the represented hardware value (as displayed).

N.B.: each parameter is exchanged as an integer number with a 16-bit sign (from –32768 to +32767).

### 39.3.1. FROM MASTER TO SINUS PENTA

| Position | 1) Code | 2) Description | 3) Range | 4) Unit of Measure | 5) Ratio |
|---|---|---|---|---|---|
| 1 | M042 | Speed reference from FIELD BUS (integer portion) | – 32000 ÷ + 32000 | rpm NOTE A) | 1 |
| 2 | M043 | Speed reference from FIELD BUS (decimal portion) | – 99 ÷ + 99 | rpm NOTE A) / NOTE B) | 1 / 100 |
| 3 | M045 | Torque reference/ Torque limit | – 5000 ÷ + 5000 | % NOTE C) | 1 / 10 |
| 4 | M047 | PID Reference | – 10000 ÷ + 10000 | % | 1 / 100 |
| 5 | M035 | Digital Inputs from FIELD BUS | – | NOTE D) | – |
| 6 | | Commando for Digital Outputs from FIELD BUS | – | NOTE E) | – |
| 7 | AO1 | Analog Output 1 controlled by FIELD BUS | + 111 ÷ + 1889 | NOTE F) | – |
| 8 | AO2 | Analog Output 2 controlled by FIELD BUS | + 111 ÷ + 1889 | NOTE F) | – |
| 9 | AO3 | Analog Output 3 controlled by FIELD BUS | + 111 ÷ + 1889 | NOTE F) | – |

**NOTE A)**
The speed reference from the FIELD BUS is obtained by adding the decimal portion/100 to the integer portion.
Example: **M042**=210; **M043**=50 ⇒ speed ref. = 210.50 rpm
This value is included in the global speed reference of the inverter (measure **M000**) along with the other reference sources if at least one of the parameters **C143** ÷ **C146** is set as 6:FieldBus.

**NOTE B)**
The decimal portion is the high byte of the word:

| bit [15..8] | bit [7..0] |
|---|---|
| Speed reference decimal portion | |

**NOTE C)**
The torque reference from the FIELD BUS is significant if at least one of the parameters **C143** ÷ **C146** is set as 6:FieldBus and if the type of reference of the active motor (parameters **C011/C054/C097**) is set as 1:Torque, or if the inverter is in slave mode from digital input.

The torque limit from the FIELD BUS is significant if parameter **C147** is set as 6:FieldBus.

**NOTE D)**
Virtual terminal board is the low byte of the word:

| bit 15 | bit [14..8] | bit [7..0] |
|---|---|---|
| 1 | | Virtual terminal board |

Bitmap:

0 → MDI1 (START)
1 → MDI2 (ENABLE)
2 → MDI3 (RESET)
3 → MDI4
4 → MDI5
5 → MDI6
6 → MDI7
7 → MDI8

The logic status of these bits is included in the overall status of the inverter digital inputs (measure **M031**) along with the other command sources if at least one of the parameters **C140** ÷ **C142** is set as 6:FieldBus.
**Important**: bit 15 must always be written =1; this means that data exchanged between the master and the inverter are consistent, thus keeping the watchdog counter reset (see Alarm **A070**).

**NOTE E)**
Digital commands from FIELD BUS are the 4 lower bytes of the word:

| | bit [3..0] |
|---|---|
| | Digital commands |

Bitmap:

| bit | Command | Position in the selection vector |
|---|---|---|
| 0 | Fbus CMD 1 | D34 |
| 1 | Fbus CMD 2 | D35 |
| 2 | Fbus CMD 3 | D36 |
| 3 | Fbus CMD 4 | D37 |

Columns 2 and 3 state the name and position of the commands sent via field bus.
Example: to control digital input 1 via field bus through command 4, set the parameters below in the Digital Outputs menu:
**P270** = 1: Digital Digital Output Mode
**P271** = D37: Fbus CMD4 Variable A Selection
**P278** = 1: True Output Logic Level

**NOTE F)**
To control analog outputs via the Field Bus, set parameter **R017** accordingly.

The correspondence between the exchanged value and the real value (in volts) of the digital outputs:

| exchanged value | voltage (V) |
|---|---|
| + 1889 | + 10 |
| + 1000 | 0 |
| + 111 | – 10 |

## 39.3.2. FROM SINUS PENTA TO MASTER

| Position | 1) Code | 2) Description | 3) Range | 4) Unit of Measure | 5) Ratio |
|---|---|---|---|---|---|
| 1 | | Status + Alarms | – | NOTE G) | – |
| 2 | M026 | Output current | 0 ÷ 65000 | A | 1 / 10 |
| 3 | M004 | Motor speed | – 32000 ÷ + 32000 | rpm | 1 |
| 4 | | Third measure that may be configured with **P330** | all the Measures | See the selected Measure | See the selected Measure |
| 5 | | Fourth measure that may be configured with **P331** | See Set Measure | See the selected Measure | See the selected Measure |
| 6 | DIN | Digital inputs | – | NOTE H) | – |
| 7 | DOU | Digital outputs | – | NOTE I) | – |
| 8 | REF | Analog input REF | – 16380 ÷ + 16380 | NOTE J) | – |
| 9 | AIN1 | Analog input AIN1 | – 16380 ÷ + 16380 | NOTE J) | – |
| 10 | AIN2 | Analog input AIN2 | – 16380 ÷ + 16380 | NOTE J) | – |

**NOTE G)**
Within the word **Status** and **Alarms** bytes are mapped as follows:

| bit [15..8] | bit [7..0] |
|---|---|
| Status | Alarms |

The **Status** codes may be found in **Table 82: Status List.**
The **Alarm** codes may be found in **Table 80: Alarm Codes List.**

**NOTE H)**
Digital input status in the word:

| bit [15..8] | bit [7..0] |
|---|---|
| | Inverter digital inputs |

Bitmap:

0 → MDI1 (START)
1 → MDI2 (ENABLE)
2 → MDI3 (RESET)
3 → MDI4
4 → MDI5
5 → MDI6
6 → MDI7
7 → MDI8

The high byte is reserved for future applications (optional boards).

**NOTE I)**
Digital output status in the word:

| bit [15..8] | bit [7..0] |
|---|---|
| | Inverter digital outputs |

Bitmap:

0 → MDO1/FOUT
1 → MDO2
2 → MDO3
3 → MDO4
6 → precharge contactor status

The high byte is reserved for future applications (optional boards).

NOTE J)
Full scale value ± 16380 is a rated value corresponding to an input range of ± 10V. This value can be altered due to automatic compensation of the input status tolerance.

## 39.4. ALARM A070 (COMMUNICATIONS SUSPENDED)

This alarm trips if Sinus Penta is not sent any legal message via FIELDBUS within the timeout set in parameter **R016**. To disable this alarm set the parameter to 0.
A legal message is the word of the digital inputs (**M035**) with bit 15=1 written by the master.
Important: this is enabled only when the inverter receives the first message with bit 15=1.

# 40. EEPROM MENU

## 40.1. Overview

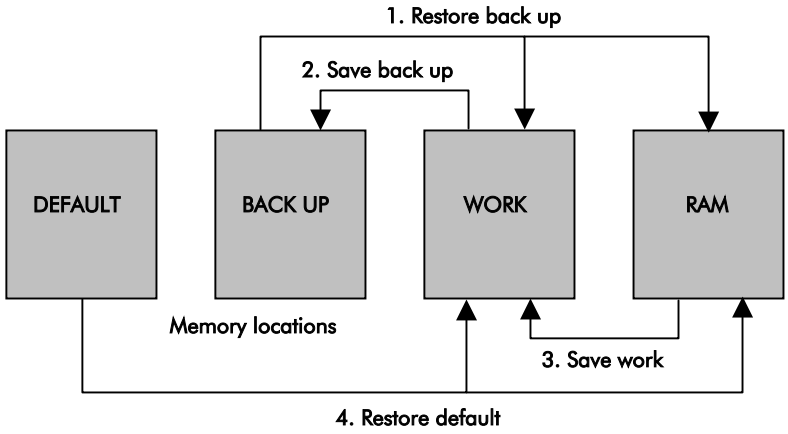
The inverter has four different memory zones:

- **RAM** → Volatile memory containing the inverter's current parameterisation;
- **Default Zone** → Non-volatile memory that cannot be accessed by the user, containing the factory-setting of the inverter parameters.
- **Work Zone** → Non-volatile memory where customised parameters are saved. Whenever the inverter is reset, this parameterisation is loaded to the RAM.
- **Back–up Zone** → Non-volatile memory storing a new inverter parameterisation. Back-up parameters are modified only when the user explicitly saves the back–up zone.

Any parameter can be changed by the user. The inverter will immediately use the new parameter value.
The user may save the parameter value in the Work zone. If no new value is saved for a given parameter, when the inverter is switched on again it will use the parameter value stored in the Work zone.

- **"P"** parameters can be written at any moment.
- With the factory-setting the "**C**" parameters (see **P003** to modify them even when fluxing and the motor is not running) can be written only if the inverter is not running and the **ENABLE** command is disabled (terminal **MDI2** open).
- "**R**" parameters have the same features as "C" parameters, but the new parameter value, once written and saved, will be used only at next power on. To use the new parameter value immediately, turn the inverter off and on or press the **RESET** key for at least 5 seconds.

The Work zone may be copied to the BACKUP zone through input **I012** included in the Eeprom menu and described in the section below.
With the same input it is possible to copy the Backup zone onto the WORK zone to restore the parameter values stored in the WORK zone.
With input **I012** it is also possible to restore the factory-setting values for all parameters in the WORK zone.



## 40.2. List of Inputs

Table 83: List of Parameter I012

| Input | FUNCTION | Access Level | MODBUS Address | Default Values |
|---|---|---|---|---|
| I012 | EEPROM Control | BASIC | 1399 | Not a parameter |

### 40.2.1. I012 EEPROM CONTROL

| | | | |
|---|---|---|---|
| I012 | Range | 0, 2, 4, 5, 11 | 0: No Command<br>2: Restore Backup<br>4: Save Backup<br>5: Save Work<br>11: Restore Default |
| | Default | Not a parameter: at power on and whenever the EEPROM command is executed, **I012** is set to zero. | |
| | Level | BASIC | |
| | Address | 1399 | |
| | Function | This parameter saves and restores the entire set of parameters that can be accessed by the user:<br><br>**2: Restore Backup**: the parameters stored in the Backup zone are copied and stored in the WORK zone. They represent the new RAM parameterisation; the previous RAM parameters are cleared. **Backup → RAM → Work;**<br><br>**4: Save Backup**: the parameters in the WORK zone are saved in a copy of the Backup zone. **Work → Backup;**<br><br>**5: Save Work**: the current values of the parameters stored in RAM are saved in the non-volatile memory in the Work zone. All the parameters are saved with this one command. **RAM → Work**;<br><br>**11: Restore Default**: factory-setting values are restored for all parameters; each factory-setting value is stored in the non-volatile memory in the Work zone. **Default → RAM → Work**. | |

# 41. ALARMS AND WARNINGS

CAUTION If a protection trips or the inverter enters the emergency mode, the inverter is locked and the motor starts idling!

## 41.1. What Happens When a Protection Trips

NOTE Before operating the inverter in emergency conditions read this and the following section **What To Do When an Alarm Trips** carefully.

The inverter alarms are detailed in the sections below.

When a protection or an alarm trips, the **ALARM** LED on the keypad comes on and the page displayed is the first page of the **TRIP LOG**.
With the factory-setting and the inverter is switched on after an alarm has tripped and was not reset it remains in the emergency condition.
**If the inverter is in emergency mode when switched on, this could be due to an alarm tripped before the inverter was reset**.
To avoid storing the alarms tripped before the inverter is switched off, set parameter **C257** in the **Autoreset Menu**.
The inverter stores the moment when an alarm trips in the **TRIP LOG** (supply–time and operation–time), in addition to the inverter status when the alarm tripped, some measures sampled when the alarm tripped are stored in the trip log.
The reading and registration of the fault–list can be very useful to detect the cause for the alarm trip and its possible solution
(see also Trip Log Menu (Fault List)).

NOTE Alarms **A001** ~ **A039** relate to the main microcontroller (DSP Motorola) of control board ES821, which detected a fault on the control board. No fault–list is available for Alarms **A001** ~ **A039** and no Reset command can be sent via serial link; alarms can be reset through the **RESET** terminal on the terminal board or the **RESET** key on the keypad. The software for the keypad interface is not available; the inverter parameters and measures cannot be accessed via serial link.
It is useless to reset alarms **A033** and **A039** as they indicate that flash memory is not provided with relative software; the only way to reset alarms **A033** and **A039** is to download relative software for the inverter flash memory.

CAUTION Before resetting an alarm, deactivate the **ENABLE** signal on terminal **MDI2** to disable the inverter and prevent the connected motor from running at uncontrolled speed, unless parameter **C181**=1 (the Safety Start function is active): after resetting an alarm or after supplying the inverter, this will start only if the **ENABLE** contact is open and closed.

## 41.2. What To Do When an Alarm Trips

CAUTION

If a protection trips or the inverter is in emergency condition, the inverter is locked and the motor starts idling!

CAUTION

Before resetting an alarm, disable the **ENABLE** signal on terminal **MDI2** to disable the inverter and to prevent the connected motor from running at uncontrolled speed.

Proceed as follows:

1. Disable the **ENABLE** signal on terminal **MDI2** to disable the inverter and to lock the motor, unless parameter **C181**=1 (the Safety Start function is active): after resetting an alarm or after supplying the inverter, this will start only if the **ENABLE** contact is open and closed.
2. If the motor is idling, wait until it stops.

Check the **TRIP LOG** carefully for any information about the alarm tripped, in order to determine the cause for the alarm and its possible solutions.

Any relative information stored in the TRIP LOG is also required when contacting Elettronica Santerno Customer Service.

3. In the following sections, find the relative alarm code and follow the instructions.
4. Solve any external problems that may have been responsible for the protection trip.
5. If the alarm tripped due to the entry of wrong parameter values, set new correct values and save them.
6. Reset the alarm.
7. If the alarm condition persists, please contact Elettronica Santerno Customer Service.

A **RESET** command must be sent to reset an alarm in one of the following ways:

- enable the signal on the terminal **RESET MDI3** of the hardware terminal board;
- press the **RESET** key on the keypad;
- enable the **RESET MDI3** signal on one of the virtual terminal boards enabled as remote control sources (see CONTROL METHOD MENU).

To activate the **Autoreset** function, enable parameter **C255** (see AUTORESET MENU) and the inverter will automatically try to reset the alarms tripped.

## 41.3. Alarms List

Table 84: Alarms List

| Alarm | Alarm Message | Description |
|---|---|---|
| A001 ÷ A032 | … | *Control board failure* |
| A033 | TEXAS VER KO | Incompatible Texas Software Version |
| A039 | FLASH KO | Texas Flash not programmed |
| A040 | A040 User Fault | Alarm caused by the user |
| A041 | A041 PWMA Fault | Generic alarm IGBT Hardware, side A |
| A043 | A043 False Interrupt | *Control board failure* |
| A044 | A044 SW OverCurrent | Software overcurrent |
| A045 | A045 Bypass Circuit Fault | Fault of the precharge By–Pass |
| A046 | A046 Bypass Connector Fault | Precharge By–Pass connector fault |
| A047 | A047 UnderVoltage | Dc bus voltage lower than Vdc_min |
| A048 | A048 OverVoltage | Dc bus voltage exceeding Vdc_max |
| A049 | A049 RAM Fault | *Control board failure* |
| A050 | A050 PWMA0 Fault | Hardware Fault from IGBT converter, side A |
| A051 | A051 PWMA1 Fault | Hardware overcurrent, side A |
| A053 | A053 PWMA Not ON | Hardware failure, IGBT A power on impossible |
| A055 | A055 PTC Alarm | External PTC tripped |
| A056 | A056 PTC Short Circuit | External PTC in short circuit |
| A059 | A059 Encoder Fault | Error of motor speed measure |
| A060 | A060 NoCurrent Fault | Current is zero in FOC control |
| A061 | A061 Ser WatchDog | Watchdog tripped in serial link 0 (D9 poles) |
| A062 | A062 SR1 WatchDog | Watchdog tripped in serial link 1 (RJ45) |
| A063 | A063 Generic Motorola | *Control board failure* |
| A064 | A064 Mains Loss | No power is supplied from the mains |
| A065 | A065 AutoTune Fault | Autotune failed |
| A066 | A066 REF < 4mA | Current input REF (4÷20mA) lower than 4mA |
| A067 | A067 AIN1 < 4mA | Current input AIN1 (4÷20mA) lower than 4mA |
| A068 | A068 AIN2 < 4mA | Current input AIN2 (4÷20mA) lower than 4mA |
| A069 | A069 No Slave | Slave mode selected with IFD control |
| A070 | A070 Fbs WatchDog | Field Bus Watchdog tripped |
| A071 | A071 1ms Interrupt OverTime | *Control board failure* |
| A072 | A072 Parm Lost Chk | Parameter download/upload error |
| A073 | A073 Parm Lost COM1 | Parameter download/upload error |
| A074 | A074 Inverter OverHeated | Inverter thermal protection tripped |
| A075 | A075 Motor OverHeated | Motor thermal protection tripped |
| A076 | A076 Speed Alarm | Motor speed too high |
| A078 | A078 MMI Trouble | *Control board failure* |
| A079 | A079 FOC No Encoder | FOC control but Encoder not enabled |
| A080 | A080 Tracking Error | Encoder speed tracking error |
| A081 | A081 KeyPad WatchDog | Communication watchdog via keypad |
| A082 | A082 Illegal Encoder Cfg | Functions programmed for MDI6 and MDI7 or encoder B selected and encoder board not detected. |
| A083 | A083 External Alarm 1 | External alarm 1 |
| A084 | A084 External Alarm 2 | External alarm 2 |
| A085 | A085 External Alarm 3 | External alarm 3 |
| A088 | A088 ADC Not Tuned | *Control board failure* |

| | | |
|---|---|---|
| **A089** | A089 Parm Lost COM2 | Parameter download/upload error |
| **A090** | A090 Parm Lost COM3 | Parameter download/upload error |
| **A091** | A091 Braking Resistor Overload | Overvoltage due to the overload of the braking resistor |
| **A092** | A092 SW Version KO | *Control board failure* |
| **A093** | A093 Bypass Circuit Open | ByPass relay open |
| **A094** | A094 HeatSink Overheated | IGBT heatsink temperature too high |
| **A096** | A096 Fan Fault | Fan alarm |
| **A097** | A097 Motor Not Connected | Motor not connected |
| **A098** | A098 Illegal Motor Selected | A motor not enabled with **C009** selected from MDI |
| **A099** | A099 2nd Sensor Fault | Fault of fan sensor 2 |
| **A100** | A100 MDI6 Illegal Configuration | Function programmed for MDI6 along with frequency input A |
| **A101** | A101 MDI8 Illegal Configuration | Function programmed for MDI8 along with frequency input B |
| **A102** | A102 REF > 20mA | Current input REF (4÷20mA or 0÷20mA) greater than 20mA |
| **A103** | A103 AIN1 > 20mA | Current input AIN1 (4÷20mA or 0÷20mA) greater than 20mA |
| **A104** | A104 AIN2 > 20mA | Current input AIN2 (4÷20mA or 0÷20mA) greater than 20mA |
| **A105 ÷ A127** | … | *Control board failure* |

## A001÷A032 Control Board Failure

| **A001÷A032** | | |
|---|---|---|
| | **Description** | Control board failure |
| | **Event** | There may be several causes: the board autodiagnostics file constantly checks its operating conditions. |
| | **Possible cause** | • Considerable electromagnetic disturbance or radiated interference.<br>• Possible failure of the microcontroller or other circuits on the control board. |
| | **Solution** | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

## A033 Texas KO Software

| **A033** | | |
|---|---|---|
| | **Description** | Incompatible Software Texas version |
| | **Event** | When switched on, DSP Motorola detected an incompatible version of the software downloaded to Flash Texas (software version incompatible with Motorola). |
| | **Possible cause** | The wrong software was downloaded. |
| | **Solution** | 1. Download the correct DSP Texas software version.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

## A039 Texas Flash not programmed

| **A039** | | |
|---|---|---|
| | **Description** | Texas Flash not programmed |
| | **Event** | When switched on, DSP Motorola detected that Flash Texas is not correctly programmed. |
| | **Possible cause** | A prior attempt to download DSP Texas software failed. |
| | **Solution** | 1. Download the correct DSP Texas software version.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A040 User Alarm

| A040 | Description | Alarm trip caused by the user (as a test) |
|---|---|---|
| | Event | The user commands the inverter to trip the alarm |
| | Possible cause | Value 1 was entered to address MODBUS 1400 via serial link. |
| | Solution | Reset the alarm: send a **RESET** command. |

A041 IGBT Fault Side A

| A041 | Description | Generic IGBT Hardware alarm, side A |
|---|---|---|
| | Event | Power converter A generated a generic alarm. |
| | Possible cause | • Electromagnetic disturbance or radiated interference.<br>• Overcurrent, IGBT overtemperature, IGBT fault. |
| | Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A044 SW Overcurrent

| A044 | Description | SW Overcurrent |
|---|---|---|
| | Event | Immediate current limit tripped. |
| | Possible cause | • Abrupt variations of the connected load<br>• Output short-circuit or ground short-circuit<br>• Considerable electromagnetic disturbance or radiated interference.<br><br>If alarm **A044** tripped while accelerating the acceleration ramp is too short.<br>If alarm **A044** tripped while decelerating the deceleration ramp is too short. |
| | Solution | 1. Check that the inverter and the motor are properly dimensioned with respect to the connected load.<br>2. Make sure that no short-circuit is to be found between two phases or between one phase and the grounding outgoing from the inverter (terminals **U, V, W**). (Remove voltage from the motor, set IFD control and operate the inverter in no-load conditions.)<br>3. Check that the command signals are sent to the inverter using screened cables where required (see the **Installation Instructions** manual). Look for any eventual external sources for electromagnetic disturbance, check wiring and make sure that antidisturbance filters are installed on the coils of contactors and electrovalves (if fitted inside the cabinet).<br>4. Set longer acceleration times (see RAMPS MENU).<br>5. Set longer deceleration times (see RAMPS MENU).<br>6. If necessary, decrease the LIMITS MENU values. |

A045 Bypass Fault

| A045 | Description | Bypass precharge Fault |
|---|---|---|
| | Event | The inverter imposed to close its relay or contactor for the short-circuit of the precharge resistors in DC-link capacitors (DC bus), but it did not detect the relevant closing signal during the precharge.<br>See also **A046**. |
| | Possible cause | • Disconnection of auxiliary signal.<br>• Precharge relay/contactor failure. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A046 Bypass Connector Fault

| A046 | Description | Precharge bypass connector fault |
|---|---|---|
| | Event | Auxiliary signal for the closing of the bypass connector of the short-circuit precharge resistor is considered as closed before the relevant closing command is sent.<br>See also **A045**. |
| | Possible cause | • Precharge bypass connector reversed.<br>• Precharge relay/contactor failure. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A047 Undervoltage

| A047 | Description | DC bus Voltage lower than minimum |
|---|---|---|
| | Event | Voltage measured in DC bus capacitors has dropped below the min. value allowed for a proper operation of the inverter class being used. |
| | Possible cause | • Supply voltage has dropped below 200Vac –25% (class 2T), 380V –35% (class 4T), 500V –15% (class 5T), 600Vac –5% (class 6T).<br>• Alarm **A047** can trip even when voltage temporarily drops below the allowable min. value (caused for example by the direct starting of the connected load).<br>• If the inverter is powered directly by the bus bar, the bus feeder is responsible for the alarm.<br>• Failure in DC bus voltage measure circuit. |
| | Solution | 1. Check voltage in terminals **R**, **S**, **T**. Check mains voltage value **M030** and DC bus voltage value **M029**. Also check the values of **M030** and **M029** sampled in the **TRIP LOG** when the alarm tripped.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A048 Overvoltage

| A048 | Description | Overvoltage in DC bus (voltage in DC-link) |
|---|---|---|
| | Event | Voltage measured in DC bus (DC-link) capacitors has exceeded the max. value allowed for a proper operation of the inverter class being used. |
| | Possible cause | • Check that voltage does not exceed 240Vac +10% (class 2T), 480V +10% (class 4T), 515Vac +10% (class 5T), 630Vac +10% (class 6T).<br>• Alarm **A048** can trip with very inertial loads and when the deceleration ramp is too short (see<br>• RAMPS MENU).<br>• Alarm **A048** can trip even when the motor is pulled by the load (eccentric load).<br>• If the inverter is powered directly by the bus bar, the bus feeder is responsible for the alarm trip.<br>• Failure in DC bus voltage measure circuit. |
| | Solution | 1. Check voltage in terminals **R**, **S**, **T**. Check mains voltage value **M030** and DC bus voltage value **M029**. Also check the values of **M030** and **M029** sampled in the **TRIP LOG** when the alarm tripped.<br>2. In case of very inertial loads and if the alarm tripped when decelerating, try to set a longer deceleration ramp. If short stop times are needed or if the motor is pulled by the load, try to activate the resistive braking unit.<br>3. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service.. |

A050 IGBT Fault A

| A050 | Description | Hardware fault from IGBT converter, side A |
|---|---|---|
| | Event | IGBT drivers of power converter A detected IGBT failure. |
| | Possible cause | • Electromagnetic disturbance or radiated interference.<br>• Overcurrent, Overtemperature, IGBTs, IGBT fault. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A051 Overcurrent HW A

| A051 | Description | Hardware overcurrent, side A |
|---|---|---|
| | Event | Hardware overcurrent detected by the inverter output current circuit. |
| | Possible cause | See **A044** Overcurrent SW. |
| | Solution | See **A044** Overcurrent SW. |

A053 Not PWONA

| A053 | Description | Hardware failure; IGBT A power on failure |
|---|---|---|
| | Event | IGBT A power on controlled by Motorola microcontroller has failed. |
| | Possible cause | Control board failure. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A055 PTC Alarm

| A055 | Description | External PTC resistor tripped |
|---|---|---|
| | Event | Detected the opening of the PTC connected to the **AIN2** input (R > 3600 ohm) |
| | Possible cause | • Opening of the PTC due to overheating of the motor.<br>• PTC incorrectly connected.<br>• Incorrect setting of the **SW1** hardware switch on the control board (see **Installation Manual**). |
| | Solution | 1. Allow the motor to cool, then reset the alarm.<br>2. Make sure that the PTC is correctly connected to the **AIN2** analog input (see **Installation Manual**).<br>3. Make sure the **SW1** hardware switch the is correctly set. |

A056 PTC Short Circuit

| A056 | Description | External PTC resistor short circuit |
|---|---|---|
| | Event | Detected the short circuit of the PTC connected to the **AIN2** input (R < 10 ohm) |
| | Possible cause | • Short circuit on the PTC.<br>• PTC incorrectly connected.<br>• Incorrect setting of the **SW1** hardware switch on the control board (see **Installation Manual**). |
| | Solution | 1. Make sure that the PTC is correctly connected to the **AIN2** analog input (see **Installation Manual**).<br>2. Make sure the **SW1** hardware switch the is correctly set. |

A059 Encoder Fault

| A059 | Description | Motor speed measure error |
|---|---|---|
| | Event | During the encoder tune, a speed error measure occurred with respect to the estimated speed, although the sign of the measured speed is consistent with the estimated speed. |
| | Possible cause | • Incorrect parameterization of the encoder concerning the type and number of pulses/rev.<br>• Voltage removed from one of the two encoders.<br>• Incorrect mounting of the encoders.<br>• Encoder failure. |
| | Solution | 1. Check that the encoder parameters are correct (see ENCODER/FREQUENCY INPUTS MENU).<br>2. Check that both encoders are properly connected.<br>3. Check mounting of the encoders.<br>4. Check that the encoder signals are correct. |

A060 No current fault FOC

| A060 | | |
|---|---|---|
| | Description | Error detected in FOC control by the current loop exceeds the max. allowable value. |
| | Event | The FOC control detected a current regulation error. |
| | Possible cause | • One motor cable is disconnected.<br>• Failure in the current measure circuit.<br>• Wrong setting of current regulator parameters for FOC control. |
| | Solution | 1. Check motor connections (terminals **U, V, W**).<br>2. Check parameterization of current regulators for FOC control (see FOC REGULATORS MENU). Perform a new current regulator autotune (see AUTOTUNE MENU).<br>3. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A061, A062 Serial Link Watchdog

| A061 (Serial Link 0)<br>A062 (Serial Link 1) | | |
|---|---|---|
| | Description | **A061**: Serial Link Watchdog 0 tripped<br>**A062**: Serial Link Watchdog 1 tripped |
| | Event | The serial link watchdog has tripped.<br>Communication failure: no reading/writing query to serial link for a time longer than the time set in the parameters relating to serial link watchdog (see SERIAL LINKS MENU). |
| | Possible cause | • Serial link is disconnected.<br>• Communication failure on remote master side.<br>• Watchdog operating times too short. |
| | Solution | 1. Check serial link.<br>2. Make sure that the remote master constantly sends reading/writing queries with max. intervals between two queries lower than the preset watchdog operating time.<br>3. Set longer watchdog operating times (see **R005** for serial link 0 and **R012** for serial link 1). |

A064 Mains Loss

| A064 | | |
|---|---|---|
| | Description | Mains loss |
| | Event | Mains loss. |
| | Possible cause | • One supply cable is disconnected.<br>• Mains supply too weak.<br>• Mains gap. |
| | Solution | 1. Check voltage in terminals **R, S, T**. Check mains voltage value **M030**. Also check the value of **M030** sampled in the **TRIP LOG** when the alarm tripped.<br>2. This protection may be disabled or delayed (see POWER DOWN MENU). |

A065 Autotune KO

| A065 | Description | Autotune failed. |
|---|---|---|
| | Event | Autotune aborted or failed. |
| | Possible cause | • The **ENABLE** contact was opened before autotune was over.<br>• Autotune aborted, maybe because the parameter values were inconsistent with the motor ratings. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. Check the motor parameters and make sure that they are consistent with the motor ratings (see MOTOR CONTROL MENU) and perform a new autotune procedure.<br>3. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A066, A067, A068 Current input < 4mA

| A066 (REF)<br>A067 (AIN1)<br>A068 (AIN2) | Description | **A066**: Current input REF (4÷20mA) lower than 4mA<br>**A067**: Current input AIN1 (4÷20mA) lower than 4mA<br>**A068**: Current input AIN2 (4÷20mA) lower than 4mA |
|---|---|---|
| | Event | A current value lower than 4 mA has been detected over input (REF, AIN1, AIN2) set with the following range: 4÷20mA. |
| | Possible cause | • Wrong setting of switch SW1 on control board ES821.<br>• Signal cable disconnected.<br>• Failure in the current signal source. |
| | Solution | 1. Check setting of switch SW1.<br>2. Check that the signal cable is properly connected to its terminal.<br>3. Check the current signal source. |

A069 Slave Mode KO

| A069 | Description | Slave mode selected with IFD control |
|---|---|---|
| | Event | **SLAVE** mode enabled with IFD control, but IFD control does not allow torque references. |
| | Possible cause | • Incorrect parameterization (type of control or master/slave mode).<br>• Incorrect enabling of digital input SLAVE. |
| | Solution | 1. Check parameters.<br>2. Check status of digital command **SLAVE**. |

A070 Field Bus WatchDog

| A070 | Description | Watchdog Field Bus tripped |
|---|---|---|
| | Event | The watchdog fieldbus tripped and communication is suspended. Communication is interrupted: the Master did not send any valid message for a time longer than the time set in the parameter relating to the value set with parameter **R016** of the field bus watchdog time (see FIELD BUS CONFIGURATION MENU). |
| | Possible cause | • Voltage removed from Field bus.<br>• No communication from Master.<br>• Watchdog times too short. |
| | Solution | 1. Check field bus connections.<br>2. Check that the master ensures a constant sequence of legal messages (see FIELD BUS CONFIGURATION MENU) with max. time intervals lower than the preset watchdog time.<br>3. Set longer watchdog times (see **R016**). |

A072-3, A089-90 Parameter Upload/Download Error from Keypad to Inverter

| A072<br>A073<br>A089<br>A090 | Description | Upload/download failed, one of the controls of the parameter consistency detected a fault |
|---|---|---|
| | Event | A communication error occurred while uploading/downloading the programming parameters from the keypad to the inverter. |
| | Possible cause | Temporary interruption to the serial link between keypad and control board. |
| | Solution | Check the connection between the keypad and the control board, reset the alarm and repeat upload/download. |

A074 Overload

| A074 | Description | Inverter thermal protection tripped |
|---|---|---|
| | Event | Output current has been exceeding the inverter rated current for long periods |
| | Possible cause | • Current greater than Imax + 20% for 3 seconds<br>• Current greater than Imax for 120 seconds (S05÷S30) or greater than Imax for 60 seconds (S40÷S70) |
| | Solution | Check the inverter current output during ordinary operation (**M026** in the **Measure Menu**); check the mechanical conditions of the connected load (load locked or overload). |

A075 Motor Overheated

| A075 | Description | Motor thermal protection tripped |
|---|---|---|
| | Event | The motor thermal protection software tripped. Output current has been exceeding the inverter rated current for long periods. |
| | Possible cause | • Poor mechanical conditions of the connected load.<br>• Wrong setting of parameters in the Thermal Protection Menu. |
| | Solution | 1. Check mechanical conditions of the connected load.<br>2. Check parameters **C265**, **C266**, **C267** (and equivalent parameters for motors 2 and 3) in the **Thermal Protection Menu.** |

A076 Limit Speed

| A076 | Description | Motor speed is too high |
|---|---|---|
| | Event | Motor speed is higher than the current value set in parameter **C031** (for motor 1, or equivalent parameters for motors 2 and 3).<br><br>If **C031** = 0, the limit speed protection is disabled.<br><br>If the encoder is disabled, the variable used for this software protection is:<br>• The current speed setpoint for IFD.<br>• The estimated motor speed for VTC control. |
| | Possible cause | • Value of Parameter **C031** too low.<br>• Torque reference too high for **SLAVE** mode. |
| | Solution | 1. Check the compatibility of the parameter with respect to the maximum speed parameter.<br>2. In **SLAVE** mode, check the torque reference value |

A079 Encoder Not Enabled

| A079 | Description | FOC control, but encoder not enabled |
|---|---|---|
| | Event | FOC control is active, but no encoder has been enabled with parameter **C012** (for motor 1, or equivalent parameters for motors 2 and 3). Otherwise, no encoder enabled for speed measure with parameter **C189** (see ENCODER/FREQUENCY INPUTS MENU). |
| | Possible cause | • **C012** = 0 (for motor 1, or equivalent parameters for motors 2 and 3). See MOTOR CONTROL MENU.<br>• The value set in **C189** does not enable any encoder for speed measure.<br>• **FOC** control has been improperly enabled. |
| | Solution | Set relative parameters correctly. |

A080 Speed Tracking

| A080 | Description | Encoder speed measure error |
|---|---|---|
| | Event | The system detected an error between the measured speed and the measure setpoint. Speed has been exceeding the value set in parameter **C193** for a time longer than the value set in parameter **C192**.<br>This protection is enabled only if parameter **C194** is not set at zero. |
| | Possible cause | • Wrong setting in parameters **C192, C193, C194** (see ENCODER/FREQUENCY INPUTS MENU).<br>• Torque limit too low.<br>• Connected load too heavy.<br>• Encoder failure, encoder mechanical joint broken down, disconnection of one of the signal cables of the encoder. |
| | Solution | 1. Set parameters **C192, C193** correctly.<br>2. Check torque limit value (see INPUT REFERENCES MENU and CONTROL METHOD MENU).<br>3. Check the mechanical load.<br>4. Make sure that the encoder works properly, check its mechanical connection to the motor and check that the encoder signal cables are properly connected to the terminals. |

A081 Keypad Watchdog

| A081 | Description | Watchdog for communication with the keypad |
|---|---|---|
| | Event | Communication failed when the keypad was enabled as a reference source or a command source or when it was in local mode (Watchdog time is equal to approx. 1.6 seconds) |
| | Possible cause | • Keypad cable disconnected.<br>• Failure of one of the two connectors of the keypad.<br>• Electromagnetic disturbance or radiated interference.<br>• Keypad failure.<br>• Incorrect setting in parameters relating to serial link 1 (see SERIAL LINKS MENU). |
| | Solution | 1. Check the connection of the keypad cable.<br>2. Make sure that the keypad cable connectors are intact (on both inverter side and keypad side).<br>3. Check communication parameters of serial link 1. |

A082 Encoder Configuration

| A082 | Description | Functions programmed for **MDI6** and **MDI7**, or **Encoder B** selected and encoder board not detected |
|---|---|---|
| | Event | • **Encoder A** has been selected for speed measure or as a reference source, but different digital command functions are programmed for terminals **MDI6** and **MDI7**.<br>• **Encoder B** has been selected for the speed measure or as a reference source, but the control board did not detect any optional encoder board. |
| | Possible cause | • Incorrect setting of the use of the encoders in parameter **C189**.<br>• Incorrect programming of digital input functions.<br>• Optional board for Encoder B is not fitted, has been improperly mounted or is faulty. Possible connector failure. |
| | Solution | 1. Check and adjust the value set in **C189** (see ENCODER/FREQUENCY INPUTS MENU).<br>2. Check and adjust control function programming for digital inputs **MDI6** and **MDI7** (see DIGITAL INPUTS MENU).<br>3. Check if optional encoder board is fitted and if it is properly mounted |

A083, A084, A085 External Alarm

| A083 (EXT1)<br>A084 (EXT2)<br>A085 (EXT3) | Description | **A083**: External alarm 1<br>**A084**: External alarm 2<br>**A085**: External alarm 3 |
|---|---|---|
| | Event | The External Alarm (1, 2, 3) functioning has been programmed, but the relevant digital input is disabled (see DIGITAL INPUTS MENU). If multiple digital command sources are programmed, alarms **A083-A085** trip if one of the terminals in the active sources is disabled (see CONTROL METHOD MENU). |
| | Possible cause | The cause for the alarm does not depend on the inverter; check for the reason why the contact connected to terminal **MDIx** where the External Alarm function is programmed opens. |
| | Solution | Check external signal. |

A091 Braking Resistor Overload

| A091 | Description | Overvoltage due to the overload of the braking resistance that operated for time equal to the maximum due to the setting in **C211** and **C212** |
|---|---|---|
| | Event | The braking resistance command was inhibited because the maximum ON time was expired and the energy caused by the regeneration (no longer dissipated) has led to overvoltage. |
| | Possible cause | This application requires the intense use of the Braking Resistor, for example lifting applications for which a long falling run is required with load applied to the motor. |
| | Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the power dissipated by the braking resistance allows for a heavier use, set **C211** with a greater ON time. |

A093 Precharge: Bypass open

| A093 | Description | Bypass relay open |
|---|---|---|
| | Event | The control board requested the closure of the bypass relay (or contactor) for the short-circuit of the DC-link capacitor precharge resistors, **but no closing signal is sent** (auxiliary of the relay) during functioning (precharge already closed). |
| | Possible cause | Failure in the relay control circuit or in the auxiliary signal circuit detecting relay closing. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

A094 Heatsink Overheated

| A094 | Description | IGBT heatsink temperature too high |
|---|---|---|
| | Event | IGBT power heatsink overheated even if the cooling fan is on (see also **A096** and **A099**). |
| | Possible cause | • Ambient temperature exceeding 40 °C.<br>• Motor overcurrent.<br>• Excessive carrier frequency for the application required (IFD control only). |
| | Solution | 1. Check ambient temperature.<br>2. Check motor current.<br>3. IFD control: decrease IGBT carrier frequency (see CARRIER FREQUENCY MENU). |

A096 Fan Fault

| A096 | Description | Fan alarm |
|---|---|---|
| | Event | Power heatsink overheated with fan locked or disconnected or faulty (see also **A094** and **A099**). |
| | Possible cause | Fan locked or disconnected or faulty. |
| | Solution | Replace fan. |

### A097 Motor Cables KO

| A097 | Description | Motor not connected |
|---|---|---|
| | Event | This protection trips during autotune or DC Brake if the motor is not connected to the inverter or if its current value is not compatible with the inverter size. |
| | Possible cause | • One cable of the motor is disconnected.<br>• The motor size is too small if compared to the inverter size. |
| | Solution | 1. Check that motor cables are properly connected to terminals **U**, **V**, **W**.<br>2. Check the motor parameters; perform autotune procedure again (VTC and FOC controls). |

### A098 Illegal Motor

| A098 | Description | A disabled motor has been selected |
|---|---|---|
| | Event | • Motor 2 is enabled, but only 1 motor can be enabled: **C009**=1 (see MOTOR CONTROL MENU).<br>• Motor 3 is enabled, but only 1 or 2 motors can be enabled: **C009**=1 or 2 (see MOTOR CONTROL MENU). |
| | Possible cause | • Incorrect setting in parameter **C009**.<br>• Incorrect setting of the digital input parameters enabling the selection functions for motor 2 (**C173**) and/or motor 3 (**C174**). |
| | Solution | 1. Check and enter the correct value for **C009**.<br>2. Check and enter the correct value for **C173**, **C174**.<br>3. Check the status of the digital commands for terminals **C173** and **C174**. If remote command sources are selected, check the status of the commands that have been sent. |

### A099 Sensor 2 Fault

| A099 | Description | Second Sensor fault |
|---|---|---|
| | Event | Power heatsink overheated with cooling fan off (see also **A094** and **A095**) |
| | Possible cause | Failure in temperature control device and/or cooling system. |
| | Solution | Contact ELETTRONICA SANTERNO Customer Service |

### A100 MDI6 Illegal Configuration

| A100 | Description | Function programmed to **MDI6** together with **frequency input A** |
|---|---|---|
| | Event | Terminal **MDI6** is programmed with both a digital function command and as frequency input **A**. |
| | Possible cause | Incorrect programming of a command function for **MDI6**, because frequency input A is already set in parameter **C189** (FinA) (see DIGITAL INPUTS MENU and ENCODER/FREQUENCY INPUTS MENU). |
| | Solution | Check and adjust programming of the digital input functions and of parameter **C189**. |

A101 MDI8 Illegal Configuration

| | | |
|---|---|---|
| A101 | Description | Function programmed to **MDI8** together with **frequency input B** |
| | Event | Terminal **MDI8** is programmed with both a digital function command and as frequency input **B**. |
| | Possible cause | Incorrect programming of a command function for **MDI8,** because frequency input B is already set in parameter **C189** (FinB) (see DIGITAL INPUTS MENU and ENCODER/FREQUENCY INPUTS MENU). |
| | Solution | Check and adjust programming of the digital input functions and of parameter **C189**. |

A102, A103, A104 Current input > 20 mA

| | | |
|---|---|---|
| A102 (REF)<br>A103 (AIN1)<br>A104 (AIN2) | Description | A102: Current input REF (4÷20mA or 0÷20mA) greater than 20mA<br>A103: Current input AIN1 (4÷20mA or 0÷20mA) greater than 20mA<br>A104: Current input AIN2 (4÷20mA or 0÷20mA) greater than 20mA |
| | Event | A current value greater than 20mA has been detected over input (REF, AIN1, AIN2) set with the following ranges: 4÷20mA or 0÷20mA. |
| | Possible cause | • Wrong setting of switch SW1 on control board ES821.<br>• Failure in the current signal source. |
| | Solution | 1. Check setting of switch SW1.<br>2. Check the current signal source. |

A001 ÷ A032, A043, A049, A063, A071, A078, A088, A092, A105 ÷ A127 Control Board failure

| | | |
|---|---|---|
| A001 ÷ A032<br>A043<br>A049<br>A063<br>A071<br>A078<br>A088<br>A092<br>A105 ÷ A127 | Description | Control board failure |
| | Event | There may be several causes: the board autodiagnostics file constantly checks its operating conditions. |
| | Possible cause | • Considerable electromagnetic disturbance or radiated interference.<br>• Possible failure of the microcontroller or other circuits on the control board. |
| | Solution | 1. Reset the alarm: send a **RESET** signal.<br>2. If the alarm persists, contact ELETTRONICA SANTERNO Customer Service. |

## 41.4. Warnings

**Warning** messages are displayed on the display/keypad. They are flashing messages that usually appear on one or two of the first three lines of the display.

NOTE Warnings are neither protections nor alarms, and are stored in the trip log.

Some warnings simply state what is happening or suggest what to do when using the keypad.
However, most of the warning messages are **Coded warnings**: they are displayed with letter **"W" followed by two digits** stating which warning is active at that moment, for example:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 3 | 2 | | O | P | E | N | | E | n | a | b | l | e |

Warning messages are detailed in the following section.

## 41.5. Warnings List

Table 85: Warnings List

| Warning | Alarm Message | Description |
|---|---|---|
| W03 | SEARCHING… | The user interface is looking for the data of the next page to display. |
| W04 | DATA READ KO | Software warnings regarding data reading. |
| W05 | DATA WRITE KO | Software warnings regarding data writing. |
| W06 | HOME SAVED | The page displayed has been saved as the home page displayed at power on. |
| W07 | DOWNLOADING | The keypad is **writing** to the drive the WORK zone parameters saved on its own flash memory. |
| W08 | UPLOADING | The keypad is **reading** from the drive the WORK zone parameters that will be saved on its own flash memory. |
| W09 | DOWNLOAD OK | The keypad successfully downloaded the parameter **writing** to the drive. |
| W10 | DOWNLOAD KO | The keypad interrupted the parameter download to the drive.<br>The parameter **writing** has failed. |
| W11 | UPLOAD OK | The keypad successfully uploaded the parameter **reading** to the drive. |
| W12 | UPLOAD KO | The keypad interrupted the parameter upload to the drive.<br>The parameter **reading** has failed. |
| W13 | NO DOWNLOAD | A Download procedure was queried, but no parameter is saved in the flash memory. |
| W16 | PLEASE WAIT… | Wait until the system completes the requested operation. |
| W17 | SAVE IMPOSSIBLE | Impossible to save parameter. |
| W18 | PARAMETERS LOST | The keypad interrupted the parameter download to the drive. The parameter **writing** has failed. Therefore not all the parameters have been updated and the parameters are inconsistent. |
| W19 | NO PARAMETERS LOAD | UPLOAD impossible. |
| W20 | NOT NOW | The required function is not available at the moment. |
| W21 | CONTROL ON | The required function is inhibited because the drive is running. |
| W23 | DOWNLOAD VER. KO | Download failed because parameters saved to keypad memory relate to a SW version or product ID incompatible with the drive SW version or product ID. |
| W24 | VERIFY DATA | Download preliminary operation underway, the system is checking the integrity and compatibility of the parameters saved in the keypad memory. |
| W28 | OPEN START | Open and close the **START** (MDI1) signal to start the drive. |
| W31 | ENCODER OK | Encoder tuning procedure finished: the encoder is correctly connected. |
| W32 | OPEN ENABLE | Open and close the **ENABLE** (MDI2) signal to enable the drive. |
| W33 | WRITE IMPOSSIBLE | Writing procedure impossible. |
| W34 | ILLEGAL DATA | Illegal value entered, operation failed. |
| W35 | NO WRITE CONTROL | Writing procedure impossible because Control is active and the drive is running. |
| W36 | ILLEGAL ADDRESS | Illegal address entered, operation failed. |
| W37 | ENABLE LOCKED | The drive is disabled and does not acknowledge the **ENABLE** command because it is writing a "C" parameter.<br>**CAUTION: The drive will start up as soon as writing is over!!!** |
| W38 | LOCKED | Editing mode cannot be accessed because parameter modification is disabled: **P000** is different from **P002**. |
| W39 | KEYPAD DISABLED | Editing mode cannot be accessed because the keypad is disabled. |
| W40 | FAN FAULT | Fan locked or disconnected or faulty. |
| W41 | SW VERSION KO | Download impossible because of different SW Versions. |
| W42 | IDP KO | Download impossible because of different IDPs (IDentification Products). |
| W43 | PIN KO | Download impossible because of different PINs (Part Identification Numbers). |
| W44 | CURRENT CLASS KO | Download impossible because of different current classes. |
| W45 | VOLTAGE CLASS KO | Download impossible because of different voltage classes. |
| W46 | DOWNLOAD KO | Download impossible (generic cause). |

## 41.6. Status List

Table 86: Status List

| Number | Status | Description |
|---|---|---|
| 0 | ALARM!!! | Alarm trips in inverter |
| 1 | START UP | Inverter is starting up |
| 2 | MAINS LOSS | Mains loss |
| 3 | TUNING | Inverter is tuning |
| 4 | SPEED SEARCHING | Searching for motor speed |
| 5 | DCB at START | DC Braking at starting |
| 6 | DCB at STOP | DC Braking at stopping |
| 7 | DCB HOLDING | DC current for holding |
| 8 | DCB MANUAL | DC Braking at starting |
| 9 | LIMIT IN ACCEL. | Current/torque limit in acceleration |
| 10 | LIMIT IN DECEL. | Current/torque limit in deceleration |
| 11 | LIMIT IN CONSTANT RPM | Current/torque limit at constant rpm |
| 12 | BRAKING | Start up braking module or extend deceleration ramp |
| 13 | CONSTANT RUN | Inverter running with speed set point reached |
| 14 | IN ACCELERATION | Inverter running with motor in acceleration stage |
| 15 | IN DECELERATION | Inverter running with motor in deceleration stage |
| 16 | INVERTER OK | Inverter on Stand-by with no alarms tripped |
| 17 | FLUXING | Motor fluxing stage |
| 18 | MOTOR FLUXED | Motor fluxed |
| 19 | FIRE MODE RUN | Constant rpm in Fire Mode |
| 20 | FIRE MODE ACCEL. | Acceleration in Fire Mode |
| 21 | FIRE MODE DECEL. | Deceleration in Fire Mode |
| 22 | INVERTER OK* | Inverter on Stand-by with no alarms tripped, however with no guarantee due to alarm trip in Fire Mode |
| 25 | SPARE | Spare mode board |
| 27 | WAIT NO ENABLE | Waiting to open **ENABLE** command |
| 28 | WAIT NO START | Waiting to open **START** command |
| 29 | PIDOUT min DISAB | Inverter disabled for PID ouptut < Min. |
| 30 | REF min DISAB. | Inverter disabled for REF < Min. |
| 31 | IFD WAIT REF. | Inverter enabled with IFD control<br>Waiting for reference in order to start |
| 32 | IFD WAIT START | Inverter enabled with IFD control<br>Waiting for START in order to start |
| 33 | DISABLE NO START | During fluxing, the RUN command was not given within the max. time set in **C183**. The inverter remains disabled until the RUN command is given |

# 42. USER PARAMETERS LIST DIFFERENT FROM THE DEFAULT

Use this list for the settings that are different from the factory-setting default values.

| PAR.-Meaning | Default values | Modified values | PAR.-Meaning | Default Values | Modified values |
|---|---|---|---|---|---|
| | | | | | |
| **P00x Access Level** | | | | | |
| **P001**-AcsLev | 0: Basic | | **P003**-ModCmode | 0: Stand-by Only | |
| | | | | | |
| **Product** | | | | | |
| **P263**-Lang | 1: English | | | | |
| | | | | | |
| **P26x Display** | | | | | |
| **P264**-ModNav | 0: Menu | | **P264a**-ModNavMenu | 1: Yes | |
| **P264b**-ModMenu | 0: Standard | | **P265**-FirstPage | 0: Status | |
| **P266**-kpd_type | 1: Active Ref. | | **P267**-umis1_PID | 0: Disable | |
| **P269**-DisabKey1 | 0: No | | **P269a**-DisabKey2 | 0: No | |
| | | | | | |
| **P00x-P03x Ramps** | | | | | |
| **P009**-Tup1 | 10.00 s | | **P010**-Tdn1 | 10.00 s | |
| **P012**-Tup2 | 10.00 s | | **P013**-Tdn2 | 10.00 s | |
| **P014**-Un.Meas1-2 | 1: 0.1 s | | **P015**-Tup3 | 10.00 s | |
| **P016**-Tdn3 | 10.00 s | | **P018**-Tup4 | 10.00 s | |
| **P019**-Tdn4 | 10.00 s | | **P020**-Un.Meas3-4 | 1: 0.1 s | |
| **P021a**-Rnd.Sel1 | 1: On | | **P021b**-Rnd.Sel2 | 1: On | |
| **P021c**-Rnd.Sel3 | 1: On | | **P021d**-Rnd.Sel4 | 1: On | |
| **P022**-RndStartAcc | 50 % | | **P023**-RndStopAcc. | 50 % | |
| **P024**-RndStartDec | 50 % | | **P025**-RndStopDec | 50 % | |
| **P026**-T Tup | 5.00 s | | **P027**-T Tdn | 5.00 s | |
| **P028**-T Un.Mea | 1: 0.1 s | | **P029**-J Tup | 1 s | |
| **P030**-J Tdn | 1 s | | **P031**-SpdAccReset | 1: Yes | |
| **P032**-TupFireM | 10.0 s | | **P033**-TdnFireM | 10.0 s | |
| | | | | | |
| **P05x-P07x Reference** | | | | | |
| **P050**-REF | 3: 0-10V | | **P051**-REFMIN | 0.0 V | |
| **P052**-REFMAX | 10.0 V | | **P053**-REFOFFS | 0.000 V | |
| **P054**-TauFilt REF | 5 ms | | **P055**-AIN1 | 2: 4-20mA | |
| **P056**-AIN1MIN | 4.0 mA | | **P057**-AIN1MAX | 20.0 mA | |
| **P058**-AIN1OFFS | 0.000 mA | | **P059**-TauFilt AIN1 | 5 ms | |
| **P060**-AIN2 | 2: 4-20mA | | **P061**-AIN2MIN | 4.0 mA | |
| **P062**-AIN2MAX | 20.0 mA | | **P063**-AIN2OFFS | 0.000 mA | |
| **P064**-TauFilt AIN2 | 5 ms | | **P065**-SpdDisab | 0 rpm | |
| **P066**-SpdDisabTime | 0 s | | **P067**-U/D Ramp | Square | |
| **P068**-U/D Mem | 1: Yes | | **P068a**-U/D1-StopRes | 0: No | |
| **P068b**-U/D2-StopRes | 0: No | | **P068c**-U/D1SwSRes | 0: No | |
| **P068d**-U/D2SwSRes | 0: No | | **P069**-U/D Range | 1: Unipolar | |
| **P070**-Jog Ref | 0 % | | **P071**-PulseMin | 10000 Hz | |
| **P072**-PulseMax | 100000 Hz | | **P073**-EncMin | -1500 rpm | |
| **P074**-EncMax | 1500 rpm | | | | |
| | | | | | |
| **P08x-P10x Multispeeds** | | | | | |
| **P080**-Mspd.use | 0:Preset Speed | | **P081**- Spd1 | 0.00 rpm | |
| **P083**-Spd2 | 0.00 rpm | | **P085**-Spd3 | 0.00 rpm | |
| **P087**-Spd4 | 0.00 rpm | | **P088**-Spd5 | 0.00 rpm | |
| **P089**-Spd6 | 0.00 rpm | | **P090**-Spd7 | 0.00 rpm | |
| **P091**-Spd8 | 0.00 rpm | | **P092**-Spd9 | 0.00 rpm | |
| **P093**-Spd10 | 0.00 rpm | | **P094**-Spd11 | 0.00 rpm | |
| **P095**-Spd12 | 0.00 rpm | | **P096**-Spd13 | 0.00 rpm | |
| **P097**-Spd14 | 0.00 rpm | | **P098**-Spd15 | 0.00 rpm | |
| **P099**-FireM_Spd | 750.00 rpm | | **P100**-Un.Meas | 0: 0.01 rpm | |

| PAR.-Meaning | Default values | Modified values | PAR.-Meaning | Default values | Modified values |
|---|---|---|---|---|---|
| | | | | | |
| **P10x Prohibit Speeds** | | | | | |
| **P105**-Velbp1 | 0 rpm | | **P106**-Velbp2 | 0 rpm | |
| **P107**-Velbp3 | 0 rpm | | **P108**-Bwbps | 0 rpm | |
| | | | | | |
| **P11x-P12x % Var. Ref.** | | | | | |
| **P115**-VarPerc1 | 0.0 % | | **P116**-VarPerc2 | 0.0 % | |
| **P117**-VarPerc3 | 0.0 % | | **P118**-VarPerc4 | 0.0 % | |
| **P119**-VarPerc5 | 0.0 % | | **P120**-VarPerc6 | 0.0 % | |
| **P121**-VarPerc7 | 0.0 % | | | | |
| **P12x-P15x Speed Loop** | | | | | |
| **P125**-Ti min M1 | 0.500 s | | **P126**-Ti max M1 | 0.500 s | |
| **P128**-Kp min M1 | 10.00 | | **P129**-Kp max M1 | 10.00 | |
| **P130**-Err.min M1 | 1.00 % | | **P131**-Err.max M1 | 1.00 % | |
| **P135**-Ti min M2 | 0.500 s | | **P136**-Ti max M2 | 0.500 s | |
| **P138**-Kp min M2 | 10.00 | | **P139**-Kp max M2 | 10.00 | |
| **P140**-Err.min M2 | 1.00 % | | **P141**-Err.max M2 | 1.00 % | |
| **P145**-Ti min M3 | 0.500 s | | **P146**-Ti max M3 | 0.500 s | |
| **P148**-Kp min M3 | 10.00 | | **P149**-Kp max M3 | 10.00 | |
| **P150**-Err.min M3 | 1.00 % | | **P151**-Err.max M3 | 1.00 % | |
| **P152**-curr_simm. | 0 % | | | | |
| **P15x-P17x FOC Regulator** | | | | | |
| **P155**-Curr_Kp M1 | 3.00 | | **P156**-Curr_Ti M1 | 20.0 ms | |
| **P158**-Flux_Kp M1 | 3.00 | | **P159**-Flux_Ti M1 | 200 ms | |
| **P162**-Curr_Kp M2 | 3.00 | | **P163**-Curr_Ti M2 | 20.0 ms | |
| **P165**-Flux_Kp M2 | 3.00 | | **P166**-Flux_Ti M2 | 200 ms | |
| **P169**-Curr_Kp M3 | 3.00 | | **P170**-Curr_Ti M3 | 20.0 ms | |
| **P172**-Flux_Kp M3 | 3.00 | | **P173**-Flux_Ti M3 | 200 ms | |
| **P17x-P21x Analog Outputs** | | | | | |
| **P176**-AO1 Mode | 1: +/-10V | | **P177**-AO1 Sel | 1: Motor Speed | |
| **P178**-AO1 Min | -1500.000 rpm | | **P179**-AO1 Max | 1500.000 rpm | |
| **P180**-AO1 Offset | 0.000 V | | **P181**-AO1 Filt | 0.000 s | |
| **P182**-AO1 Out_min | -10.0 V | | **P183**-AO1 Out_max | 10.0 V | |
| **P184**-AO2 Mode | 1: +/-10V | | **P185**-AO2 Sel | 2: Speed Ref. | |
| **P186**-AO2 Min | -1500.000 rpm | | **P187**-AO2 Max | 1500.000 rpm | |
| **P188**-AO2 Offset | 0.000 V | | **P189**-AO2 Filt | 0.000 s | |
| **P190**-AO2 Out_min | -10.0 V | | **P191**-AO2 Out_max | 10.0 V | |
| **P192**-AO3 Mode | 1: +/-10V | | **P193**-AO3 Sel | 5:Motor Current | |
| **P194**-AO3 Min | 0.000 A | | **P195**-AO3 Max | 36.000 A | |
| **P196**-AO3 Offset | 0.000 V | | **P197**-AO3 Filt | 0.000 s | |
| **P198**-AO3 Out_min | -10.0 V | | **P199**-AO3 Out_max | 10.0 V | |
| **P200**-PulsOut Mode | 0: Disabled | | **P201**-PlsOut Sel | 1: Motor Speed | |
| **P202**-Pls Out Min | 0 rpm | | **P203**-Pls Out Max | 0 rpm | |
| **P204**-Pls Out Fmax | 10.00 kHz | | **P205**-Pls Out Fmin | 100.00 kHz | |
| **P206**-Pls Out Filt | 0.000 s | | **P207**-AO1Gain | 0.100 | |
| **P208**-AO2Gain | 0.100 | | **P209**-AO3Gain | 0.100 | |
| **P210**-AO1Address | 2611 | | **P211**-AO2Address | 2611 | |
| **P212**-AO3Address | 2611 | | **P213**-Sin Amp | 100.0 % | |
| **P214**-Sin Freq | 1.00 Hz | | **P215**-Saw Freq | 1.000 Hz | |

| PAR.-Meaning | Default Values | Modified values | PAR.-Meaning | Default Values | Modified values |
|---|---|---|---|---|---|
| | | | | | |
| **P21x-P22x Timers** | | | | | |
| **P216**-T1 delay On | 0.0 s | | **P217**-T1 delay Off | 0.0 s | |
| **P218**-T2 delay On | 0.0 s | | **P219**-T2 delay Off | 0.0 s | |
| **P220**-T3 delay On | 0.0 s | | **P221**-T3 delay Off | 0.0 s | |
| **P222**-T4 delay On | 0.0 s | | **P223**-T4 delay Off | 0.0 s | |
| **P224**-T5 delay On | 0.0 s | | **P225**-T5 delay Off | 0.0 s | |
| **P226a**-Timer MDI1 | 0 | | **P226b**-Timer MDI2 | 0 | |
| **P226c**-Timer MDI3 | 0 | | **P226d**-Timer MDI4 | 0 | |
| **P227a**-Timer MDI5 | 0 | | **P227b**-Timer MDI6 | 0 | |
| **P227c**-Timer MDI7 | 0 | | **P227d**-Timer MDI8 | 0 | |
| **P228a**-Timer MDO1 | 0 | | **P228b**-Timer MDO2 | 0 | |
| **P228c**-Timer MDO3 | 0 | | **P228d**-Timer MDO4 | 0 | |
| | | | | | |
| **P23x-P25x PID Parameters** | | | | | |
| **P236**-PID Out Max | 100.00 % | | **P237**-PID Out Min- | 100.00 % | |
| **P238**-Integ Max | 100.00 % | | **P239**-Der Max | 100.00 % | |
| **P240**-PID Kp | 1.000 | | **P241**-PID KpMult | 0: 1 | |
| **P242**-PID Ti(Tc) | 500 Tc | | **P243**-PID Td(Tc) | 0 mTc | |
| **P244**-PID Tc | 5 ms | | **P245**-PID Ref Min | 0.00 % | |
| **P246**-PID Ref Max | 100.00 % | | **P247**-PID Fdbk Min | 0.00 % | |
| **P248**-PID Fdbk Max | 100.00 % | | **P249**-PID Tup | 0.00 s | |
| **P250**-PID Tdn | 0.00 s | | **P251**-PID U.Mea. | 1: 0.1 s | |
| **P252**-Rnd start | 50 % | | **P253**-Rnd stop | 50 % | |
| **P254**-Thresh Int | 0.0 %\|Refmax\| | | **P255**-Disab Time | Disabled | |
| **P256**-Trate Lim | 1 ms | | **P257**-GainScale | 1.000 | |
| | | | | | |
| **P27x-P30x Digital Outputs** | | | | | |
| **P270**-Out1Mode | 3: Analog | | **P271**-Out1Sel1 | A51: Speed | |
| **P272**-Out1Sel2 | A51: Speed | | **P273**-Out1 Test1 | 0: > | |
| **P274**-Out1 Test2 | 3: <= | | **P275**-D01 ValTst1 | 50.000 rpm | |
| **P276**-D01 ValTst2 | 10.000 rpm | | **P277**-Out1Func | 1: (A) Set (B) Reset | |
| **P278**-Out1Logic | 1: True | | **P279**-Out2Mode | 6: Brake | |
| **P280**-Out2Sel1 | A61: Torque Output | | **P281**-Out2Sel2 | A51: Speed | |
| **P282**-Out2 Test1 | 0: > | | **P283**-Out2 Test2 | 3: <= | |
| **P284**-D02 ValTst1 | 20.000 % | | **P285**-D02 ValTst2 | 50.000 rpm | |
| **P286**-Out2Func | 1: (A) Set (B) Reset | | **P287**-Out2Logic | 1: True | |
| **P288**-Out3Mode | 1: Digital | | **P289**-Out3Sel1 | D2: Inverter Ok On | |
| **P290**-Out3Sel2 | D2: Inverter Ok On | | **P291**-Out3 Test1 | 0: > | |
| **P292**-Out3 Test2 | 0: > | | **P293**-D03 ValTst1 | 0.000 | |
| **P294**-D03 ValTst2 | 0.000 | | **P295**-Out3Func | 0: (A) OR (B) | |
| **P296**-Out3Logic | 1: True | | **P297**-Out4Mode | 1: Digital | |
| **P298**-Out4Sel1 | D1: Inverter Run Ok | | **P299**-Out4Sel2 | D1: Inverter Run Ok | |
| **P300**-Out4 Test1 | 0: > | | **P301**-Out4 Test2 | 0: > | |
| **P302**-D04 ValTst1 | 0.000 | | **P303**-D04 ValTst2 | 0.000 | |
| **P304**-Out4Func | 0: (A) OR (B) | | **P305**-Out4Logic | 1: True | |
| | | | | | |
| **P33x Field Bus Parameters** | | | | | |
| **P330**-fbs_meas3 | M012 Torq.Out.% | | **P331**-fbs_meas4 | M022 PID Out% | |
| | | | | | |
| **C00x Carrier Frequencies** | | | | | |
| **C001**-Fcarr Min | [*] | | **C002**-Fcarr Max | [*] | |
| **C003**-Npulse | 1: 24 | | **C004**-SilentMode | 1: Yes | |

| PAR.-Meaning | Default values | Modified values | PAR.-Meaning | Default values | Modified values |
|---|---|---|---|---|---|
| **C00x-C04x Motor Control M1** | | | | | |
| **C008**-VmainsNom | [**] | | **C009**-Mot.Numb. | 1 | |
| **C010**-Ctrl.Type M1 | 0: IFD | | **C011**-RefMode M1 | 0: Speed | |
| **C012**-EncEnab M1 | 0: No | | **C013**-v_f_mode1 | 0: Constant Torque | |
| **C015**-Fmot M1 | 50.0 Hz | | **C016**-n mot M1 | 1420 rpm | |
| **C017**-Pnom M1 | [*] | | **C018**-Inom M1 | [*] | |
| **C019**-Vnom M1 | [**] | | **C020**-P0 M1 | 0.0 % | |
| **C021**-i0 M1 | 0 % | | **C022**-Rstat M1 | [*] | |
| **C023**-Ld M1 | [*] | | **C024**-Lm M1 | 250.00 mH | |
| **C025**-TauRot M1 | [*] | | **C028**-nmin M1 | 0 rpm | |
| **C029**-nmax M1 | 1500 rpm | | **C030**-spddeflux M1 | 90 % | |
| **C031**-nsa M1 | Disabled | | **C032**-red_Trq1 | 30.0 % | |
| **C033**-spd_redTrq1 | 20 % | | **C034**-Preboost M1 | [*] | |
| **C035**-Boost0 M1 | 0 % | | **C036**-Boost M1 | 0 % | |
| **C037**-FrqBst | 50 % | | **C038**-AutoBst | 1 % | |
| **C039**-SlipComp. M1 | Disabled | | **C040**-DV_M1 | Disabled | |
| **C041**-Tfl M1 [*] | | | | | |
| **C04x-C05x Limits M1** | | | | | |
| **C043**-Iacclim1 | [*] | | **C044**-Irunlim1 | [*] | |
| **C045**-Ideclim1 | [*] | | **C046**-defilimRed1 | 0: No | |
| **C047**-Tmin M1 | 0.0 % | | **C048**-Tmax M1 | [*] | |
| **C049**-Tlim Ramp M1 | 50ms | | **C050**-NoDimfM1 | 0: No | |
| **C05x-C08x Motor Control M2** | | | | | |
| **C053**-Ctrl.Type M2 | 0: IFD | | **C054**-RefMode M2 | 0: Speed | |
| **C055**-EncEnab M2 | 0: No | | **C056**-v_f_mode2 | 0: Constant Torque | |
| **C058**-Fmot M2 | 50.0 Hz | | **C059**-n mot M2 | 1420 rpm | |
| **C060**-Pnom M2 | [*] | | **C061**-Inom M2 | [*] | |
| **C062**-Vnom M2 | [**] | | **C063**-P0 M2 | 0.0 % | |
| **C064**-i0 M2 | 0 % | | **C065**-Rstat M2 | [*] | |
| **C066**-Ld M2 | [*] | | **C067**-Lm M2 | 250.00 mH | |
| **C068**-TauRot M2 | [*] | | **C071**-nmin M2 | 0 rpm | |
| **C072**-nmax M2 | 1500 rpm | | **C073**-spddeflux M2 | 90 % | |
| **C074**-nsa M2 | Disabled | | **C075**-red_Trq2 | 30.0 % | |
| **C076**-spd_redTrq2 | 20 % | | **C077**-Preboost M2 | [*] | |
| **C078**-Boost0 M2 | 0 % | | **C079**-Boost M2 | 0 % | |
| **C080**-FrqBst | 50 % | | **C081**-AutoBst | 1 % | |
| **C082**-SlipComp. M2 | Disabled | | **C083**-DV_M2 | Disabled | |
| **C084**-Tfl M2 | [*] | | | | |
| **C08x-C09x Limits M2** | | | | | |
| **C086**-Iacclim2 | [*] | | **C087**-Irunlim2 | [*] | |
| **C088**-Ideclim2 | [*] | | **C089**-defilimRed2 | 0: No | |
| **C090**-Tmin M2 | 0.0 % | | **C091**-Tmax M2 | [*] | |
| **C092**-Tlim Ramp M2 | 50ms | | **C093**-NoDimfM2 | 0: No | |
| **C09x-C12x Motor Control M3** | | | | | |
| **C096**-Ctrl.Type M3 | 0: IFD | | **C097**-RefMode M3 | 0: Speed | |
| **C098**-EncEnab M3 | 0: No | | **C099**-v_f_mode3 | 0: Constant Torque | |
| **C101**-Fmot M3 | 50.0 Hz | | **C102**-n mot M3 | 1420 rpm | |
| **C103**-Pnom M3 | [*] | | **C104**-Inom M3 | [*] | |
| **C105**-Vnom M3 | [**] | | **C106**-P0 M3 | 0.0 % | |
| **C107**-i0 M3 | 0 % | | **C108**-Rstat M3 | [*] | |
| **C109**-Ld M3 | [*] | | **C110**-Lm M3 | 250.00 mH | |
| **C111**-TauRot M3 | 0 ms | | **C114**-nmin M3 | 0 rpm | |
| **C115**-nmax M3 | 1500 rpm | | **C116**-spddeflux M3 | 90 % | |
| **C117**-nsa M3 | Disabled | | **C118**-red_Trq3 | 30.0 % | |
| **C119**-spd_redTrq3 | 20 % | | **C120**-Preboost M3 | [*] | |
| **C121**-Boost0 M3 | 0 % | | **C122**-Boost M3 | 0 % | |
| **C123**-FrqBst | 50 % | | **C124**-AutoBst | 1 % | |
| **C125**-SlipComp. M3 | Disabled | | **C126**-DV_M3 | Disabled | |
| **C127**-Tfl M3 | [*] | | | | |

| PAR.-Meaning | Default values | Modified values | PAR.-Meaning | Default values | Modified values |
|---|---|---|---|---|---|
| | | | | | |
| **C12x-C13x Limits M3** | | | | | |
| **C129**-Iacclim3 | [*] | | **C130**-Irunlim3 | [*] | |
| **C131**-Ideclim3 | [*] | | **C132**-defilimRed3 | 0: No | |
| **C133**-Tmin M3 | 0.0 % | | **C134**-Tmax M3] | [* | |
| **C135**-Tlim Ramp M3 | 50ms | | **C136**-NoDimfM3 | 0: No | |
| | | | | | |
| **C14x Control Method** | | | | | |
| **C140**-Sel Comm 1 | 1: Terminals | | **C141**-Sel Comm 2 | 1: Terminals | |
| **C142**-Sel Comm 3 | 0: Disabled | | **C143**-Sel InRef 1 | 1: REF | |
| **C144**-Sel InRef 2 | 2: AIN1 | | **C145**-Sel InRef 3 | 0: Disabled | |
| **C146**-Sel InRef 4 | 0: Disabled | | **C147**-Sel T lim | 0: Disabled | |
| **C148**-RemLoc_mode | 0: StandBy + Fluxing | | | | |
| | | | | | |
| **C15x-C18x Digital Inputs** | | | | | |
| | | | **C149a**-StartB | 0: None | |
| **C150**-Stop | 0: None | | **C150a**-StopB | 0: None | |
| **C151**-Rev | 0: None | | **C15a1**-RevB | 0: None | |
| **C152**-Enable S | 0: None | | **C153**-Disable | 0: None | |
| **C154**-DisabReset | 0: No | | **C155**-MItsp 0 | 4: MDI4 | |
| **C156**-MItsp 1 | 5: MDI5 | | **C157**-MItsp 2 | 0: None | |
| **C158**-MItsp 3 | 0: None | | **C159**-Cw-CCw | 8: MDI8 | |
| **C160**-DCB | 0: None | | **C161**-Up | 0: None | |
| **C162**-Down | 0: None | | **C163**-U/D Reset | 0: None | |
| **C164**-ExtAlrm 1 | 0: None | | **C164a**-ExtAlr1Delay | 0 ms | |
| **C165**-ExtAlrm 2 | 0: None | | **C165a**-ExtAlr2Delay | 0 ms | |
| **C166**-ExtAlrm 3 | 0: None | | **C166a**-ExtAlr3Delay | 0 ms | |
| **C167**-MItRmp 0 | 0: None | | **C168**-MItRmp 1 | 0: None | |
| **C169**-Jog | 0: None | | **C170**-Master/Slave | 0: None | |
| **C171**-PID disab. | 0: None | | **C172**-Keypad lock | 0: None | |
| **C173**-2nd Mot. | 0: None | | **C174**-3rd Mot. | 0: None | |
| **C175**-PercSpd 0 | 0: None | | **C176**-PercSpd 1 | 0: None | |
| **C177**-PercSpd 2 | 0: None | | **C178**-PIDud_res | 0: None | |
| **C179**-SourceSel | 6: MDI6 | | **C180**-Loc/Rem | 7: MDI7 | |
| **C180a**-Loc/RemType | 2:Pushbutton+Storage | | **C181**-Safe Start | 0: Disabled | |
| **C182**-MultiProg | 0: Disabled | | **C183**-Tflux_dis | AlwaysON | |
| **C184**-StartFlux | 0: No | | **C185**-StartFrWheel | 0: Dec. Ramp | |
| **C186**-FireMode | 0: None | | **C187**-DisabExtTlim | 0: None | |
| | | | | | |
| **C18x-C19x Encoder/Frequency Input** | | | | | |
| **C189**-UseEnc | 0: A / B Unused | | **C190**-pulsEncA | 1024 | |
| **C191**-pulsEncB | 1024 | | **C192**-SpdAlrTime | 5.00 s | |
| **C193**-SpdErr | 300 rpm | | **C194**-TrackAlrEn | 1: Enable | |
| **C195**-tauFiltFdbk | 5.0 ms | | **C196**-tauFiltRef | 5.0 ms | |
| **C197**-nCH ENCA | 0:.2Ch. Quad | | **C198**-nCH ENCB. | 0: 2Ch. Quad | |
| **C199**-EncSign | 0: Fdbk.NO Ref.NO | | | | |
| | | | | | |
| **C21x Braking Unit** | | | | | |
| **C210**-Enab/Vel BrakeO | 0.20 | | **C211**-BrakeTon | 2.00 s | |
| **C212**-BrkDutyCycle | 10 % | | | | |
| | | | | | |
| **C21x-C22x DC Braking** | | | | | |
| **C215**-Enab dcb stop | 0: No | | **C216**-Enab dcb start | 0: No | |
| **C217**-Tdcb stop s | 0.5 | | **C218**-Tdcb start | 0.5 s | |
| **C219**-dcb speed | 50 rpm | | **C220**-I dcb | 100 % | |
| **C221**-I dcb hold | 0 % | | **C222**-Tdefl M1 | 50 ms | |
| **C223**-Tdefl M2 | 50 ms | | **C224**-Tdefl M3 | 50 ms | |
| | | | | | |
| **C22x-C23x Power Down** | | | | | |
| **C225**-pwd type | 0: Disabled | | **C226**-Tpdd | 10 ms | |
| **C227**-Tpddec | 20 s | | **C228**-Pddecboost | 0.10 % | |
| **C229**-Pddcder | 1 | | **C230**-Vpddel | [**] | |
| **C231**-Kpvdclc | 0.050 | | **C232**-Kivdclc | 0.500s | |
| **C234**-stopmode | 0: Stop | | **C235**-stoplev | 0 rpm | |

| PAR.-Meaning | Default values | Modified values | PAR.-Meaning | Default values | Modified values |
|---|---|---|---|---|---|
| | | | | | |
| **C24x Speed Searching** | | | | | |
| **C245**-Enab SpdSch | 1: Yes | | **C246**-tssd | 1 s | |
| **C247**-Rate | 10 % | | **C248**-Is | 75 % | |
| **C249**-SpsSpd | 0: Last Speed | | | | |
| | | | | | |
| **C25x AutoReset** | | | | | |
| **C255**-nPulsRes | Disable | | **C256**-T ResCyc | 300 s | |
| **C257**-PowOnRes | 0: No | | **C258**-UvMlStore | 0: No | |
| | | | | | |
| **C26x-C27x Thermal Protection** | | | | | |
| **C264**-FanTemp | 50 °C | | **C265**-ThermProt M1 | 0: No | |
| **C266**-ThermCurr M | 120 % | | **C267**-ThermConstM1 | 600 s | |
| **C268**-ThermProt M2 | 0: No | | **C269**-ThermCurr M2 | 120 % | |
| **C270**-ThermConstM2 | 600 s | | **C271**-ThermProt M3 | 0: No | |
| **C272**-ThermCurr M3 | 120 % | | **C273**-ThermConstM3 | 600 s | |
| | | | | | |
| **C28x-C29x PID Configuration** | | | | | |
| **C285**-Sel InPID 1 | 2: AIN1 | | **C286**-Sel InPID 2 | 0: Disabled | |
| **C287**-Sel InPID 3 | 0: Disabled | | **C288**-Sel Fdbk 1 PID | 3: AIN2/PTC | |
| **C289**-Sel Fdbk 2 PID | 0: Disable | | **C290**-Sel Fdbk 3 PID | 0: Disable | |
| **C291**-PID Mode | 0: Disable | | **C292**-Der Mode | 0: Measure | |
| **C293**-PID Struct | 0: No | | **C294**-PID Act | 1: Reference | |
| | | | | | |
| **C30x Crane** | | | | | |
| **C300**-StartTrq | 0.0 % | | **C301**-t_StartTrq | 0 ms | |
| **C302**-Brk_On | 0: None | | | | |
| | | | | | |
| **R00x-R01x Serial Link** | | | | | |
| **R001**-com_slaveaddr | 1 | | **R002**-com_answdelay | 5 ms | |
| **R003**-sc0_baudrate | 38400 bps | | **R004**-com_4time_delay | 2 ms | |
| **R005**-ser_wdg_time | 0.0 s | | **R006**-parity sc0 | 1: No , 2 Stop Bit | |
| **R008**-cm1_slaveaddr | 1 | | **R009**-cm1_answdelay | 5 ms | |
| **R010**-sc1_baudrate | 38400 bps | | **R011**-cm1_4time_delay | 2 ms | |
| **R012**-sr1_wdg_time | 0.0 s | | **R013**-parity sc1 | 1: No , 2 Stop Bit | |
| | | | | | |
| **R01x Field Bus Configuration** | | | | | |
| **R016**-fbs_wdg_time | 0 ms | | **R017a**-AO1_fb_sel | 0: No | |
| **R017b**-AO2_fb_sel | 0: No | | **R017c**-AO3_fb_sel | 0: No | |

**Key:**
[*] parameter depending on the current size
[**] parameter depending on the voltage class

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